THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE RESPONSIBILITY OF COLLIERY MANAGERS.

AGAIN we have to draw attention to the extremely illogical attitude of the Home Office towards the responsibility of colliery managers in regard to the use of electricity in mines, as evidenced by the recent prosecutions of the Fife Coal Co.'s officials, already reported in our columns. The prosecutions also showed the very unsatisfactory way in which the special rules regulating the use of electricity in mines are being administered.

As will be remembered, Mr. Charles Augustus Carlow, general manager of the company; Mr. Henry Rowan, agent for the Western District collieries; and Mr. Henry Richardson, manager for three of the pits, were charged "That they (1) caused or permitted to be used two switches and two fuses which were not sufficient in size and power; (2) caused or permitted to be used in the switch-room, without being earthed, a metallic cover provided to prevent accidental contact with live parts; (3) caused or permitted to be used two gate-end or terminal boxes which were not in any way fixed, and of which one was not efficiently earthed, and the other was not earthed at all; (4) caused or permitted the unarmoured conductors or distribution cables in the main haulage road not to be efficiently covered and safeguarded; (5) caused or permitted the unarmoured conductors or distribution cables in the main haulage road and in two haulage roads leading to the coal face from the main haulage road to be fixed within reach of injury from passing tubs or trains, and not to be protected by a suitable covering," in the Foulford pit. Two days were occupied in hearing the evidence, and in the end Sheriff Shennan dismissed the case against Mr. Carlow and found Mr. Rowan and Mr. Richardson not guilty.

It may be interesting to examine the relationship of the above-named officials of the Fife Coal Co. to one another, as it was evidently the intention of the Home Office to make each of the defendants equally culpable. Mr. Carlow, then, as general manager of the company, is the head, and is almost, if not purely, directly responsible to the shareholders of the Fife Coal Co. for the commercial side of the undertaking. The position is open to anyone with or without mining experience, the requisite qualifications being managerial tact and commercial experience. Mr. Rowan, as mines agent, is directly responsible to Mr. Carlow for the working of the group of mines under his charge. The position is usually filled by a mining engineer with a first-class certificate of competency, though it is to be noted here that this is *not necessary*, and the owners may appoint anyone as agent with or without a certificate. Mr. Richardson, as the certificated colliery manager, is directly responsible to Mr. Rowan, as agent, for the working of the colliery, and to the law for any breach

of the Coal Mines Regulation Act. The position can *only* be filled by a mining engineer having a first-class certificate of competency, who must have served for at least *five* years underground. Notification of the appointment of a colliery manager must be given to H.M. Inspector of Mines for the district; this is also usual in the case of the agent, and it was given in this instance. In addition, however, to these officials, the company employ an electrical engineer, who is in charge of the electrical plant at all their collieries, but has no responsibility except that implied by virtue of his position. He is not in the least recognised by the law, and it seems to us that a splendid opportunity for rendering a service to everyone connected with mining has been missed by Sheriff Shennan in his not making a point of this fact.

Turning next to the counts, it will be safe to assume that none of the defendants had any great electrical engineering experience or knowledge, and that they would be entirely dependent upon the advice of the electrical contractors who installed the plant, in which case the colliery manager would have to accept responsibility, or upon the firm's electrical engineer, who, in our opinion, ought to take full responsibility, and not the colliery manager. In either case, however, we can also assume that the manager, knowing his responsibility, would not rest until assured that the plant was satisfactory, and would convince himself of this fact so far as his knowledge, experience, or opportunity would allow him. What are the facts? Two switches are alleged to be faulty, yet the electrical experts—who ought to know—said, in their evidence, that they were quite satisfactory, and were in general use, and further that, to carry out the Home Office Rule (with reference to "earthing") would be *actually to increase* the danger. On the one hand, we have the Home Office electrical experts making a rule, and, on the other, electrical experts insisting that rigid compliance with such a rule will increase rather than lessen the danger. Yet the colliery manager is to be responsible! Surely he is between the devil and the deep sea!

On the third count we again have a diversity of opinion on the question of earthing, one witness stating "that he could point to cases where the earthing of the gate-end box would be a positive danger. The man who suggested a bell wire in connection with the earthing of a gate-end box had not a sense of his responsibility." With this we are in entire agreement. In a mine there can be only one way of obtaining an "absolute earth"; and that is to carry a separate copper "earth" wire. To depend upon the armouring of cables for an efficient earth would be futile, and it can be easily shown that more accidents have occurred with armoured cables than with unarmoured. With reference to count (4), which also applies to count (5), what is meant by "efficiently covered and safeguarded"? This is a rule which has never been satisfactorily interpreted. It would, however, be a hardship upon the coal mining industry if the Home Office were to insist upon all cables used underground being armoured.

As already mentioned, the prosecution failed, and it is difficult to see how they could ever have hoped to succeed; at any rate, it would have been a morally unjust conviction if they had. As Sheriff Shennan stated, "If the authorities regarded the question of switches and fuses as urgent they must frame special rules, fixing the type that was to be permitted, or at least the type that was forbidden." If, however, rules were to be drafted prescribing a particular type for all colliery electrical plant, there would be an end to progress, and a blow would be given to the extended introduction of electricity in mines, from which it would take a long time to recover, in spite of the fact that it has proved so beneficial in the past. As it is, these "rules" and prosecutions are already beginning to have their effect upon colliery managers, who are now hesitating about the introduction of electricity, and in some cases are seriously contemplating the removal of their existing plant. In the North of England a number of electrically-driven coal-cutting machines have already been taken out of the pits.

What, then, is the remedy for all this chaos? We repeat the suggestion we have made over and over again, and that is, to appoint qualified engineers, give them a proper status and make them responsible for all the machinery. This we venture to point out is the only logical and satisfactory solution, in spite of the *Colliery Guardian's* bogey of "dual responsibility." There can be no dual responsibility if there is an agent, as the mining engineer or colliery manager and the mechanical engineer would each be responsible to the agent for his department. And in cases where there is no separate agent, the owners can appoint *either* to act as agent. It will have to come in the end, and the sooner the better for everybody concerned, not the least being the working miner, who is now suffering from the fact that "the law is a hass."

LORD CHARLES BERESFORD AND THE ENGINEER OFFICERS OF THE NAVY.

We have consistently taken the view that in a highly technical service like that of the Navy—where every element of hulls, armament and auxiliary machinery involves engineering principles, and demands for its proper maintenance knowledge of engineering science—the engineer officer is at least as important as his brother officers who specialise for navigating, torpedo, or gunnery duties. Consistently, too, we have maintained that the rank and status of the engineer officer should be neither less nor more than that of his technical colleagues in the ward room, and that the profession of engineering is as worthy of honour in His Majesty's ships as is the profession of navigation or gunnery. Tradition, however, still regards the engineer officer as an interloper, and it gives the older technical branches of the service undue distinctions derived from the age of wind-propelled vessels. The public, who cannot be expected to follow minutely the details affecting the matter, are generally of opinion that all these disabilities of engineer officers were got rid of when Lord Selborne accepted a scheme based upon "common entry" for all cadets, and supported by engineering studies and engineering training right up to the period when, as lieutenants, the young officers proceed to specialise either for the gunnery, torpedo, marine, navigation, or engineer branches. But the truth is that while all the new-scheme officers are indeed to merge into the full enjoyment of the honours and dignities of the "military" branch of the Navy, the old-scheme engineer officers remain in degraded exclusion from the "military" branch. The explanation is that every service member of the Admiralty is himself of the "military" branch, and consequently entirely out of sympathy with, and blind to the meaning of, engineering. They thus stand in the way of progress, they fail to see the effect of their obstinacy upon discipline, they exhibit a remarkable lack of appreciation of what engineering has done for them and for the Navy, and they fail to realise the injury that results to the whole brotherhood of naval officers from their hesitancy.

Lord Charles Beresford, in 1903, summed up the position in words that at this moment may well be brought to remembrance. He was reported by the *Western Morning News* to have said: "The executive officer of to-day should possess an intimate knowledge of all that relates to his profession. Up to now he has been fairly educated in the different branches. The most important, however—in that we depend entirely upon it—that relating to steam and machinery, has been neglected. The duties of this branch

have been delegated to, and well and loyally performed by, a body of officers existing for this special purpose, and there have been two results. The executive officer has remained ignorant of one of the most important parts of his profession; *the engineer officer has never received that recognition to which the importance of his duties and responsibilities so justly entitles him.*"

Six years have come and gone, and those words still stand as a rebuke to the Admiralty and to the Empire, and as a menace to the welfare of the Navy. Is it because the engineer officers of the present *régime* have failed in their duty? Is it because they have failed to master the technicalities of new vessels? Is it because they have failed to respond under conditions of war? Is it because in knowledge they are behind their brother technical officers? The answer is No—all the time, No! They have brought success out of failure in the change from cylindrical boilers to water-tube boilers. They have done equal service in the change from reciprocating engines to turbines, coal to oil fuel; *Powerfuls* to *Dreadnoughts*. At Ladysmith, Modder River and Pekin they fought, and they led. Who will say they were non-combatant? Then, as to their knowledge, the professional engineer officer educated through Keyham and Greenwich had the best education in the service; and in sports Keyham has a record that shows the stuff of which engineer officers are made. There is no reason for maintaining the inequality. None—but prejudice. It must be stamped out. Looking ahead, there are even more potent reasons for adjusting these disabilities, but as we do not wish in any way to hamper the progress of the new scheme, we refrain from enforcing arguments that would militate against its success. The case, moreover, is sufficiently strong on its own merits. Again, it would be unwise to use as a lever a scheme upon which the whole future of the Empire is balanced.

We are at a crisis in our history—a crisis heightened by the fact that at a moment of political tumult, the strongest naval administration of modern times is simultaneously giving place to what, in great measure, will be a new administration. The Board may review with pride the extent of their achievements. But if they fail to provide for continuity in their schemes, they fail altogether. So great an administration can scarcely be guilty of so great a blunder. It is satisfactory to observe that Engineer-Captain Bennington obtained from Lord Charles some answers that make for continuity. Lord Charles has expressed himself as being "strongly in favour of the new scheme of training as brought forward by Lord Selborne." He allows that "great trouble will occur" if adjustments between the old scheme officers and the new are not made, but he still hesitates to drive home these admissions to their logical conclusions by advocating positively that engineer officers should at once be given the "military" titles, uniforms and prerogatives, that alone can put an end to the discord and degradation that to-day is rankling, and that to-morrow may poison the service. We quote Lord Charles, not because we accept his statements in general as a guide to what is true concerning the Navy—far from it—but because he is an executive officer, and because he has frequently fought against the worst that remains of tradition. Rather would we quote Lord Nelson, who to Lord Howe wrote: "I had the happiness to command a band of brothers; *therefore night was to my advantage.*" Nelson thus recognised that unity is an element of strength in tactics and in strategy. It is towards this end that all efforts of naval officers, in all branches, and even at the Admiralty, should be directed—for the Nelson "touch" was the "touch" of brotherhood.

The Best Material for Brake-Blocks.

A DETERMINED campaign is being carried out by the Tramways and Light Railways Association through their Special Committee, to further the work already begun by themselves and by the Municipal Tramways Association, and they are employed chiefly at the present time in trying to settle once and for all the best material to use for brake-blocks. This has been the subject of considerable controversy since tramcar braking became a really serious matter, and we have little doubt but that many persons have made inquiries and researches into the question for their own satisfaction, and in some cases have come to definite conclusions, but the majority have had to be content to go on in relative darkness until some authoritative person or body should set to work to grind out the whole problem upon scientific principles guided by practical experience.

The October issue of the *Official Circular* contained an important contribution towards the solution of the problem. This consists of a paper by Prof. Ernest Wilson, recording tests made for the Brakes Committee upon Brake-block Coefficients of Friction.

We trust that all good tramway men, whether serving municipalities or companies, will help themselves and their colleagues so far as they can, and to this end we suggest that they should read Prof. Wilson's paper and send to the secretary of the T. & L.R.A. for a copy of the memorandum of procedure to be adopted by those who carry out tests. Prof. Wilson's tests were made upon a truck turned upside down in a laboratory, and are valuable so far as they go, and inasmuch as they have provided pointers for further tests of a more practical nature; but it is the results of the latter tests which will be used in any recommendations or report which may be issued in due season by the Committee. It is essential, therefore, that many tests should be made in many places, in order to obtain the highest diversity factor of conditions; and these tests would not be nearly so valuable if they were not carried out uniformly. Therefore, it is desirable that every engineer who undertakes to help the Brakes Committee should carry out his observations upon the fixed lines laid down by the Committee itself.

We can do no more here than give the merest outline of Prof. Wilson's test, as constant references are made in the paper to the tables which accompany it.

The materials tested were oak and poplar (with the grain horizontal); Frood's lining (two qualities); and soft grey cast-iron. The wheel tires were made of chilled steel. Velocities up to 22 miles per hour were dealt with, and specific loadings up to 120 lb. per sq. in. were employed. Two distinct series of tests were made—one under wet conditions, and one under dry conditions. Clean water only was used in the former tests.

The enormous superiority of cast-iron over non-metal linings, when water or other lubricant is present, is confirmed, the ratio of superiority being of the order of 10:1. In every case the coefficient falls with an increase of speed, and, with the exception of cast-iron, rises with an increased specific load.

When tested dry all the coefficients are brought to a higher level than under wet test conditions for the same speeds and loads, and in the case of non-metallic blocks, the differences are enormous, the coefficients being raised even beyond those for cast-iron. On the other hand, it is curious to observe that the coefficients of all the materials tested dry diminish with a rising specific load.

Prof. Wilson has misgivings as to the general reliability of non-metallic blocks for *tramway* purposes on account of the effect of water, and if it were not for the fact that road material mixed with water increases the coefficient of friction, he would find it difficult to believe that these substances could be trusted in wet weather for track-brake purposes.

Once or twice during the tests upon non-metallic blocks with water lubrication, combined with low temperature, the motors raced with a specific load of 120 lb. per sq. in., and it is possible that some of the worst runaway accidents have been due in part to this phenomenon, for "it is just when a car is about to descend an incline that the worst possible conditions may obtain. The blocks may be saturated with water, and the temperature of wheels and blocks may be low. The coefficient will not be sufficient at first to generate the heat required to evaporate the film of water between the blocks and wheels, with the result that racing may occur" (p. 1076).

It was noticed during these tests that the driving wheel on each axle furthest from the spur-wheel became corrugated, the number of corrugations corresponding with the

number of teeth on the spur-wheel. This effect was attributed to the spring of the shaft combined with imperfect gearing, and may be connected with rail corrugation on tramways.

Copper.

From Messrs. Merton's report for the 15th of this month, it would seem that visible supplies have at last reached their maximum at 107,185 tons, as the increase over the return for the end of last month is only 1,442 tons. The price has at present a tendency to harden, owing, probably, to the uneasy state of the market due to combination rumours. The re-shipments of standard to the States (indicating generally advance of consumption over local supply) are still maintained, at 50 tons for the fortnight. Australian and Chilian shipments are up to average, and the supplies from Spain and Portugal show considerably above (for the fortnight). The supplies from North America, as is to be expected, are down. The indications are in favour of heavy consumption, or accumulation, in the States.

A New Institution.

Elsewhere in this issue we record the proceedings at the inaugural meeting of the new "Institution of Mining Electrical Engineers" at Manchester, and this we do with the greater pleasure seeing that we may claim a large share in the birth of this society; for it was in our leader of December 11th, 1908, that the suggestion was put forward that such a body should be formed, and correspondence was invited on the subject, which ultimately, thanks mainly to the energy and organising ability of one of our correspondents, Mr. J. G. Williams, led to the formation of a capable committee and to the establishment of the Institution on what we hope will prove to be a sound and enduring basis. The rapidity with which the idea was taken up and developed was remarkable; barely 12 months from the publication of the original suggestion the Institution was in existence, provided with a complete working organisation, and already it is the parent of several branches at the principal British mining centres, while the formation of Colonial branches has now begun, and thus the Institution bids fair to become one of world-wide influence and reputation. With the greatest cordiality and pleasure we offer our congratulations and good wishes to the youngest of our electrical engineering institutions, which, we trust, will thrive abundantly. We may be permitted, in the capacity of sponsors of the infant society, to utter a word of warning as to the supreme necessity for the exercise of care and discrimination in the enrolment of new members, though we do not doubt that the Council already appreciates the importance of this, upon which depend the future prestige and stability of the Institution. Recommendation of candidates by men of standing *from personal knowledge*, and, in addition, direct inquiry and verification of the qualifications alleged, should be regarded as indispensable preliminaries not only to first election, but also to promotion from one class to another. Founded thus on personal merit and technical ability, the Institution will be enabled to claim, and obtain, for its members due recognition as men who may be relied upon to know their work and to do their duty.

Electricity and Fire Risk.

Compelled by the exigencies of time and the postal service to go to press before the resumption of the inquest upon the victims of the Clapham Junction fire, we are unable to record or comment upon the findings of the jury; and unfortunately such inquiries as we have been able to make have brought forth no new evidence as to the cause of that disastrous event. One fact, however, has come to our knowledge, which in the interests of safety ought to be made public property: and that is, that it is possible for the hot filaments falling from a broken incandescent lamp to ignite cotton wool situated several inches beneath the lamp. This, we believe, will surprise many of our readers, as it surprised ourselves; but if they doubt the truth of the statement, they can easily satisfy themselves of its accuracy by making the experiment.

The very fact that users of the electric light have acquired the habit of placing glow lamps in close proximity to materials of the most inflammable nature, such as cotton wool and celluloid, is in itself conclusive proof of the extraordinary freedom of electricity from fire risk, and of the confidence of the public in its safety; unfortunately their confidence has been carried too far. No one would dream of putting cotton wool in the neighbourhood of a gas burner of any description—the danger is too obvious; but with electric lamps the case is different. Properly installed, the electric light is by far the safest of all illuminants—witness its exclusive use in factories where explosives are manufactured—but that when unwisely used it still retains an element of danger is undeniable. We trust that the warning will be laid to heart, and we should be glad to see the use of lamps promiscuously slung about shop windows and similar places on flexibles prohibited entirely. There is not merely no need for this mode of lighting; it is altogether contrary to the accepted principles of scientific illumination, one of the first of which is that the source of light should not be within the range of vision. There are admirable and economical methods of obtaining any desired degree of illumination whatever, with fixed electric lamps, free from the slightest element of fire risk, and these are far preferable on every ground.

As for the burning of the Yarmouth Pier Pavilion, to which we referred in a hasty note last week, our information to the effect that there was not the least evidence that electricity had anything to do with the fire has been fully confirmed. A great deal of harm is done to the electrical industry by these reckless suggestions, against which we cannot protest too strongly.

Metallic-Filament Lamps.

The paper by Mr. F. H. R. Lavender, an abstract of which is published elsewhere in this issue, contains many features of interest; the subject is one of very great importance, and well worthy of minute investigation. So far as the author's conclusions regarding the "smashing point" are concerned, he appears to have taken a narrow and unpractical view of this. We agree with some of the speakers in the discussion (reported last week) that he has really proved that there is no period in the life of a metallic-filament lamp of average quality when it would pay to smash it. As a matter of fact, the smashing-point question is one of purely academic interest, even in the case of carbon-filament lamps. Mr. Maurice Solomon put the case in a nutshell when he said that the smashing point was reached only when the light emitted was inadequate for the purpose for which it was required.

On the whole, the lamps passed triumphantly through the ordeal, and the claims made on their behalf of long life and small loss of candle-power, with high efficiency, were fully justified. It appears also that the common practice of under-running them is uncalled for; on the contrary, there would be some advantage in running them a few per cent. over normal, if a steady voltage could be depended upon, but on a commercial circuit it would be preferable to supply them at the voltage marked upon them.

The author, referring to the area of bulb exposed to blackening, apparently overlooks the fact that the distribution of the film of deposit follows approximately the same law as the distribution of light; there is no advantage whatever in this respect in using a large bulb, for the percentage loss of light is in both cases the same. True, the larger bulb may look cleaner to the eye, and the vacuum may be better maintained—but these are side issues.

The author's measurements of the temperature of the bulbs are of especial interest. It will be noticed that the bulb of an old tantalum lamp nearly reaches boiling point, and that of one old tungsten lamp 79°, so that in either case it would be very dangerous to place the lamp near inflammable material—especially celluloid.

FINANCIAL EQUATIONS FOR CENTRAL STATIONS.

By L. CROUCH.

Central station practice is now so far standardised as to enable certain average assumptions to be made concerning the fixed and running charges per KW.-hour. Basing the assumptions upon data collected during the last 10 years, M. Jean Mathieu (in *La Lumière Electrique*, October 9th, 1909) evolves certain mathematical relationships which enable a ready estimation to be made of the probable financial stability of any proposed installation. In the original article the coefficients of the various terms of the equations are chosen to suit the metric system, but converting these to enable the use of English measures, the

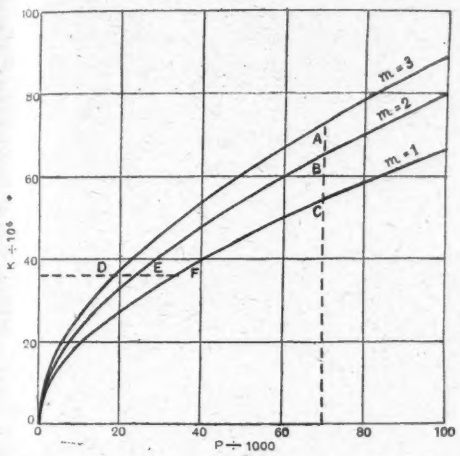


Fig. 1.

following results are obtained, the whole information being finally compressed to the curves of fig. 1, and one simple equation.

Assuming the case of an ordinary central station supplying energy for power and lighting within its own immediate neighbourhood (*i.e.*, with no long-distance transmissions), let—

A = share capital of such an enterprise,
O = capital obligations of same,
C = capital expended to equip the installation completely,
P = horse-power of machines installed,
K = critical number of KW.-hours to be sold per annum to ensure financial stability.

The financial equation to be deduced is that connecting the above quantities. The imperative condition is profitable working; the revenue obtained must pay all interest charges and a normal dividend, redeem the establishment capital, and cover all maintenance, operating and general charges. Such an equation defines the limits of financial equilibrium of the concern. If the station produces a greater number of KW.-hours than K, there will be a balance enabling the formation of a substantial reserve, or possibly of a supplementary dividend. If the annual output falls below K, the normal dividend cannot be declared, and the general and working costs may hardly be covered.

Apart from all current generation, the annual fixed charges of the enterprise are—

$$A\,d + O\,t + C\,a + F_g,$$

where
d = dividend (as fraction of capital),
t = rate of interest on loan,
a = coefficient of redemption,
F_g = general costs corresponding to the sum $(A\,d + O\,t + C\,a)$.

The general costs may be taken to be 30 per cent. of the sum $(A\,d + O\,t + C\,a)$, and 30 per cent. of the working costs, and may, therefore, be allowed for by multiplying all the costs, fixed and variable, by 1·3.

Variable costs.—These comprise the costs of coal, water, oil, salaries, repair of machines, &c., and may be respectively represented by—

$$c + e + h + s + E.$$

Then, denoting the mean selling price per KW.-hour by v, the financial equation becomes:—

$$(A\,d + O\,t + C\,a + c + e + h + s + E)\,1{\cdot}3 = K\,v \quad (1)$$

which can be reduced to a much more concrete form.

Thus O and A can be expressed as a function of C, and c, h, s, E as functions of P. The only costs which are, in practice, variable with K are c and e (coal and water); these can be expressed as $f(K)$.

In general, $A = C = 2 \times O$,
$d = 0{\cdot}05$,
$t = 0{\cdot}04$,
$a = 0{\cdot}07$,

while M. Mathieu's analysis of central stations in operation during the last 10 years authorises the following formulæ:—

$$\begin{cases} C = 2{,}800\sqrt{P}, \\ s = 32\sqrt{P} \text{ (supposing all machines are used on peak load)}, \\ h + E = 0{\cdot}16\ P \text{ (P = horse-power; C, } s, h, E = \text{pounds sterling)}. \end{cases}$$

As regards $(c + e)$, the coal and water charges may be lumped together, since the water is generally obtained by electrically-driven pumps supplied by the station generators. A representative figure for the coal per KW.-hour delivered to the system appears to be 3·30 lb., and adopting a mean price of £0·000365 per lb. (·0872d. per lb.)—

$$r = {\cdot}000365 \times 3{\cdot}3 = £0{\cdot}0012 \text{ per KW.-hour.}$$

The mean price of sale v depends on the ratio of the power and lighting rates and on the KW.-hours sold at each rate. If K_f and K_l = KW.-hours sold for power and lighting respectively, and v_f, v_l = corresponding prices per unit—

then
$$v = \frac{v_f K_f + v_l K_l}{K_f + K_l},$$

and
$$K_f + K_l = K.$$

Now
$$\left.\begin{matrix} v_f = £0{\cdot}003 \\ v_l = £0{\cdot}006 \end{matrix}\right\} \text{on the average,}$$

and putting $K_f = m\,K_l$

$$v = \frac{£{\cdot}003m + {\cdot}006}{m + 1},$$

substituting which values in equation (1) we have—

$$(2{,}800\sqrt{P} \times {\cdot}05 + 1{,}400\sqrt{P} \times {\cdot}04 + 2{,}800\sqrt{P} \times {\cdot}07 + {\cdot}0012\,K + {\cdot}16\,P + 32\sqrt{P})\,1{\cdot}3 = \frac{{\cdot}003\,m + {\cdot}006}{m + 1} \cdot K,$$

whence
$$\frac{{\cdot}00144\,m + {\cdot}00444}{m + 1} \cdot K = 551{\cdot}2\sqrt{P} + 0{\cdot}208\,P.$$

In any given district the value of m is known: usually it lies between 1 and 3; considering, therefore, the three typical cases in which $m = 1$, 2 and 3 (*i.e.*, power KW.-hours = 1, 2 or 3 × lighting KW.-hours),

$$\left.\begin{matrix} \text{for } m = 1 : K = 187{,}500\sqrt{P} + 70{\cdot}75\,P \\ m = 2 : K = 225{,}900\sqrt{P} + 85{\cdot}25\,P \\ m = 3 : K = 251{,}700\sqrt{P} + 95{\cdot}00\,P \end{matrix}\right\} \quad \ldots \quad (2)$$

which three equations are represented by the curves of fig. 1.

The availability of these curves is of considerable service in the preliminary scheming of a central station. In particular, they enable the solution of the following two inverse problems:—

1. What is the minimum annual KW.-hours that a station of total horse-power P must sell to be financially stable?

2. What must be the horse-power of a station to produce K KW.-hours per year, and what should be the capital engaged in the scheme?

As illustrating these points and the use of the formulæ generally, the following numerical examples may be studied:—

Numerical Examples:—I. Assume a 70,000-H.P. installation: for financial stability the yearly output of such a station should be:—

(*a*) With $m = 3 : 73 \times 10^6$ KW.-hours per annum (fig. 1) = 203,000 KW.-hours per diem., giving a daily return of—

$$\frac{\cdot009 + \cdot006}{4} \times 203{,}000 = £761{\cdot}25.$$

(*b*) With $m = 2 : 65 \times 10^6$ KW.-hours per annum (fig. 1) = 180,500 KW.-hours per diem, giving a daily return of

$$\frac{\cdot006 + \cdot006}{3} \times 180{,}500 = £722.$$

(*c*) With $m = 1 : 55{,}000{,}000$ KW.-hours (fig. 1), *i.e.*, 153,000-KW.-hours per day, giving a daily return of

$$\frac{\cdot003 + \cdot006}{2} \times 153{,}000 = £688{\cdot}5,$$

and, finally, the installation should cost—

$$C = 2{,}800\sqrt{70{,}000} = £741{,}000.$$

II.—Suppose a station is required to yield 100,000 KW.-hours per day = 36×10^6 KW.-hours per year, the horse-power and capital should be as follows:

(*d*) With $m = 3 : P = 18{,}800$ (fig. 1),

receipts per day = ·00,375 × 100,000 = £375,

capital A = $2{,}800\sqrt{18{,}800}$ = £383,900 (net),

and liabilities = $C = \frac{A}{2}$ = £191,950.

(*e*) With $m = 2 : P = 23{,}000$ (fig. 1),

receipts per day = ·004 × 100,000 = £400,

capital A = $2{,}800\sqrt{23{,}000}$ = £424,650 (net),

and liabilities = £212,330.

(*f*) With $m = 1 : P = 33{,}000$ (fig 1),

receipts per day = ·0045 × 100,000 = £450,

capital A = $2{,}800\sqrt{33{,}000}$ = £508,650 (net),

and liabilities = £254,330.

OZONE: ITS ELECTRICAL PRODUCTION AND USE.

By A. MABILLE.

The recent decision of the St. Petersburg Municipal Duma and City Authorities to install electrical ozonisers for sterilising the City drinking water supply, may serve to waken up our English municipal people and the electrical trade, to give attention to the possibilities of ozone in this connection. On the Continent there are a large number of cities having such ozone installations: for instance, Paris, treating 10 million gallons per day, Nice treating 5 million gallons, Dinard, St. Servain, Cosne Sulina, &c., while, strange to say, not one single British city or town appears to have given the matter any attention whatever. This is the more surprising as the cost of treatment is exceedingly low—viz., from 0·75 to 1 unit per 1,000 gallons, while as to the efficiency of the process there can be no doubt, seeing that the Pasteur and the Koch Institutes have fully investigated the matter, and shown that ozone can be relied on to completely destroy any bacteria in the water. A study of the subject is therefore of importance, as the electrical engineer can work hand-in-hand with the sanitary engineer in this branch of science, to the benefit of both parties; indeed, the study of ionisation of air and radio-activity may in the near future yield most important results. Dr. Napier Shaw referred to the ionisation of air in his evidence before the Select Committee of the House of Commons, but was not able to give any definite data as to its practical application, while although we now know that rain water is strongly radio-active (while tap-water is quite inactive) we have but vague ideas at present as to the effect of the electrical and radio-active conditions of air on animal life. Ozone is strongly radio-active. Ozone, an allotrophic modification of oxygen, is produced by the passage of the silent electrical discharge across an air space; if moisture is present, nitric acid and nitrous oxides are also produced, but by keeping the voltage low the production of nitric acid and nitrous oxides is reduced to a negligible quantity, so that the properly-designed modern ozoniser may be said to be quite free as far as nitric acid production is concerned. Air breaks down and allows a brush discharge to take place when the potential gradient exceeds about 18,000 volts per centimetre, ozone being freely produced; nitric acid is not produced unless the voltage is considerably above that required to produce ozone, provided excessive moisture is not present. Most ozonisers work at from 2,500 to 5,000 volts, the two electrodes being about $\frac{3}{16}$ in. apart, with a glass plate in between $\frac{3}{32}$ in. thick, so that the air-space is about $\frac{3}{32}$ in. across. This glass plate between the electrodes (in small ozonisers it usually has an aluminium foil covering pasted on one side to form one electrode), prevents any arcing across, and incidentally also raises the potential drop across the air-gap by reason of the higher specific inductive capacity of the glass. The violet brush discharge passing over the air-gap converts the oxygen of the air, O_2, into ozone, O_3, provided the condenser plates are kept cool, the conversion ceasing if any considerable temperature rise takes place. In large apparatus the electrodes are usually water-cooled. In the case of a town supply, the air is generally sucked through the battery of ozonisers by means of an air pump, and then driven to a mixing tank or sterilising column, where the water entering at the top in a fine spray, meets the current of ozonised air, and is thoroughly commingled with the same, the water being thus completely sterilised, and ready to be delivered into the town supply reservoir.

A small domestic apparatus is now on the market, in which the air is sucked through the ozoniser by means of an emulser fixed on the outlet of the water tap, this emulser serving the double purpose of an air pump and ozone mixer. This apparatus will treat 60 gallons of water per hour, and takes approximately 50 watts; the emulser has no moving parts, and cannot, therefore, get out of order. Using a small apparatus of this description, M. Neisser found that with water at a pressure of 30 lb. per sq. in., the number of germs was reduced from 43,000 to 2 per cubic centimetre, and that even microbes of the staphylococcus or coli bact. class were instantly killed.

In the ozone apparatus, the germs are actually killed, whereas in the ordinary mechanical type of filter they are merely held back by the filtering medium, which in time is liable to become very foul and act as an actual breeding place for the microbes. Carbon filters are particularly faulty in this respect, it being essential frequently to sterilise the carbon blocks by heating them—a process that is tedious and is generally neglected by the ordinary householder. Hence these filters are a positive danger in themselves. Ozone possesses both taste and smell, and is thus distinct from oxygen, which has neither. However, the flavour of water treated with ozone is not at all impaired; indeed, the added oxygen appears to give the water a distinctly refreshing taste.

The sanitary engineer will be more concerned with the disinfecting properties of ozone, as likely to be of help to him in the prevention of "zymotic" diseases. The pathogenic or disease-producing bacteria consist principally of three groups:—*Micrococci* (more or less spherical in shape), *bacilli* (of rod-like shape), and *spirilla* (which derive their name from their spiral shape), none of which appear able to survive the poisoning action of ozone. This is important, for according to Dr. Koch's experiments, sporeless bacilli are only killed after five minutes' treatment by a 5 per cent. solution of carbolic acid, and are not even injured by a 1 per cent. solution, while the spore-bearing bacilli will resist a temperature of over 212° F.

Clearly, therefore, there should be a field for ozone for the flushing and disinfecting of sewers and house drains, especially in view of the fact that ozone destroys sulphuretted hydrogen, and would thus probably be far more effective in dealing with the gas from sewer ventilation pipes than the

present method of burning the gas by the use of special gas lamps.

Air ozonisers have already been extensively used for hospital and sick-room disinfecting, but the use of any form or ozoniser for sewer work has up to the present not been tried. While sea air contains from 3 to 5 per cent. of ozone, the percentage of ozone in sick-room air is, as a rule, very minute indeed, hence the use of air ozonisers for hospitals is now finding considerable favour. The *Lancet*, in May last, advocated the use of the stem drinking glass, owing to the liability of the fingers to touch the brim of the ordinary tumbler; yet the same medical paper totally ignores the far greater risk of infectious disease being spread by reason of the absence of any attempt to sterilise the drinking glasses used in public bars, restaurants, &c. A glass after being used by a person, possibly in the last stages of consumption, is washed in lukewarm water, frequently none too clean, and then used for the next customer without any thought as to whether the glass is germ free or not.

Much consumption undoubtedly is spread in this way, and the matter is one which the manufacturers of ozone apparatus might find well worthy of close attention. Once the general public have their attention drawn to this point, they will insist on the hospital and restaurant managers using suitable precautions.

In dealing with tuberculosis the health authorities "strain at a gnat and swallow a camel"; spitting notices are hung everywhere, but little or no attempt is taken to enforce their observance, as is proved by the filthy state of railway carriages and tramcars. A consumptive tenant may live in a house for years, but unless he actually dies in the house, no steps are taken to disinfect the rooms before the house is re-let to a new tenant.

The oxidising and bleaching properties of ozone should ensure a wide use of this agent for manufacturing purposes.

In concentrated form its bleaching properties are superior to those of chlorine, vegetable colours, fats and oils being easily bleached by ozone. It may be noted that ozone transforms (owing to its being a powerful oxidiser), most of the lower oxides into peroxides, and nitrites into nitrates, and that iron, zinc, lead, silver and arsenic are oxidised by it; further, it is insoluble (or almost so) in acids and alkalis. In the manufacture of glue, grease, tallow, oil, &c., the bleaching action of ozone may prove of much value; as a matter of fact, it is already attracting considerable attention as a bleaching agent for flour, its germ-destroying effect on diseased grain being a valuable property in this connection. The flour is passed into a revolving tumbler drum, where it is thoroughly exposed to the action of the ozone. As the use of chlorine and nitrogen peroxide is now likely to be forbidden by the health and food authorities as being injurious, the use of ozone for flour bleaching will probably become very general. An article recently appeared in one of the weekly papers, strongly condemning this electrical bleaching of flour, but as the writer in question stated that the current was used to produce oxides of nitrogen, it can only be concluded that he had not studied the ozone process at all. One objection to any form of bleaching, is that inferior flour is made to have the appearance of a much superior grade, maize flour being thus passed off as wheat flour.

Apart from its bleaching effect, however, the action of ozone would be very beneficial on any portion of the flour that was derived from diseased grain, as already mentioned, and we know, from the experience of the Italians, how detrimental to health such diseased flour may be.

Prof. Lombroso traced the origin of the disease called the "pellagra," prevalent among the peasantry of Northern Italy, to the use as a food of diseased maize.

Taking air as being composed of 21 volumes of oxygen and 79 volumes of inert gases—chiefly nitrogen—it follows that, by the conversion of the oxygen into ozone (O_2 into O_3), approximately 14 per cent. of ozone should theoretically be produced. In practice, 10 to 12 per cent. is the maximum amount obtainable.

For many bleaching purposes (oils, for instance) a larger percentage of ozone is sometimes required, and in such instances a diluted mixture of oxygen must be passed through the ozonisers, the air being, as a rule, first passed through a scrubber containing strong caustic soda solution, which absorbs any carbon dioxide that may be present. The oil to be bleached should be heated to about 150° F., and in some cases 200° to 220° F.—siccative oils, for instance. Most of the vegetable oils are readily bleached by a 10 per cent. ozone treatment, while tallow and fat are readily freed from any rancidity and musty flavour. Turpentine has the property of absorbing ozone without being decomposed by it.

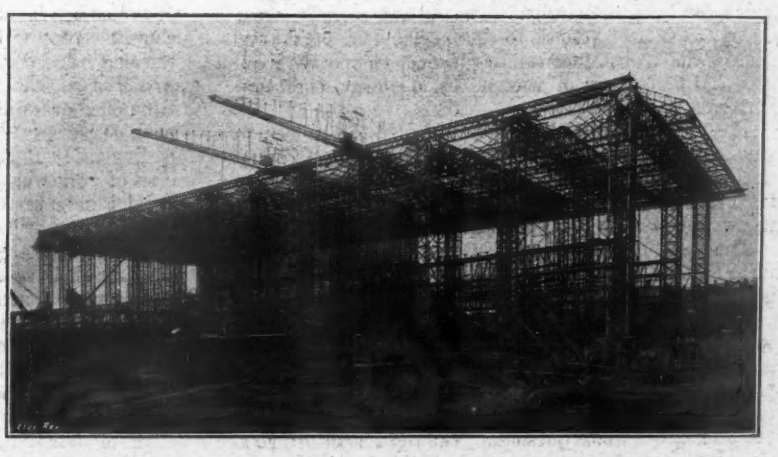
For bleaching textile material, wood, silk, &c., ozone has the great advantage of being quite as powerful as chlorine and not nearly so destructive to the fabric.

There does not seem to be any very satisfactory chemical test for ozone, the usual iodide of potassium (red litmus) test being unreliable, unless care is taken to check that the action is not due to ammonia. The sense of smell is very delicate, most minute quantities of ozone being readily detected; what is wanted, however, is a simple and accurate method of readily determining the percentage of ozone present.

From what has been said it will be seen that ozone has a wide field of usefulness, and the whole subject is one that ought to receive considerably more attention from the electrical trade than has been bestowed on it up to the present.

NEW CANTILEVER CRANES.

Our illustration gives a view of the immense glass-roofed shed covering two of the ship-building berths at the Wallsend Shipyard. The shed is 740 ft. long and about 150 ft. high, the clear inside width of the two berths being 100 ft. and 95 ft. respectively. These sheds are fully equipped with overhead travelling electric cranes. Our illustration, however, is given more particularly to show two cantilever cranes lately erected on the top of the sheds, so as to serve floating docks or ships which may be built beneath them. The cranes consist of a central truck with elevated tower, supporting large steel cables extending to the extreme end of the jib and also to the tail part which carries the machinery and ballast.



Electrical Cantilever Cranes at a Wallsend Shipyard.

Special care was exercised in the design of the cranes so as to make them as light and as strong as possible. The front cantilever is constructed of steel tubes supported at intervals by steel vertical lattice columns. The length

of the cantilever jib is approximately 100 ft., while the tail part has a projection of 40 ft.

The cranes will lift 5 tons up to 34 ft., and 1¾ tons up to 100 ft. radius from the front rail. The work they will have to do is to deal with steel plates and sectional material for the construction of floating docks and ships. The cranes have three separate sets of electric motors for hoisting, racking, and travelling. Direct current at 240 volts is conveyed to the cranes by two trolley wires running the whole length of the berths.

Hoisting is done by a 25-H.P. motor, series wound, with powerful electrical and mechanical brakes, the rope being coiled on a very large drum. There is also an over-winding device to prevent the pulley block being lifted too far. The racking motion is driven by a 5-H.P. motor with electric brake. The travelling motion is worked by a 25-H.P. motor with both electrical and mechanical brakes. The hoisting speed for 5 tons is 60 ft. per min.; lighter weights are lifted more quickly up to a maximum of 150 ft. per min. The racking speed is 60 ft. per minute, loaded, and the travelling speed when the crane is loaded is 400 ft. per min.

An ingenious device has been fitted, by means of which, as soon as an excessive load is applied, an automatic switch in the driver's cabin comes into operation, and instantly prevents the load from being lifted or racked outwards, although permitting the load being lowered or racked inwards. Adequate means have also been provided to prevent any possible derailment.

These cranes were manufactured by Joseph Booth & Bros., Ltd., of Rodley, near Leeds, and the girder track on which they run was designed, constructed and erected by Swan, Hunter & Wigham Richardson, Ltd.

EMIGRATION.

By ERNEST T. WILLIAMS.

THE overcrowded state of the electrical profession has caused more attention to be paid to the question of emigration than formerly.

Undoubtedly emigration offers opportunities and advantages which are too little understood or appreciated. This may be due to several causes, amongst which over-caution, inherent dislike of leaving the native land, and doubts of success, take an important place.

Another factor is the record of those who have emigrated and report unsatisfactorily. The writer recently crossed Canada from the Atlantic to the Pacific, and took advantage of the many opportunities which offered to inquire into the probability of success of qualified engineering immigrants.

The result of these inquiries confirmed the opinion previously held and published in an article in the REVIEW, on September 13th, 1907, entitled, "The Electrical Engineering Profession: On Going Abroad," viz., that many young fellows would do well to emigrate.

The principal essential of success, in the Colonies even more than at home, is character; given this, the man who goes to Canada to-day is almost bound to succeed.

The possibilities appear to be endless, and the average man would have opportunities there, which he is very unlikely to get at home. Discussing the possibility of emigrating, a young engineer recently said he would require certain funds to keep him until he got something suitable to do. Here is the crux of the whole question. The right man will go and *do something* until he can get *something suitable* to do. Many cases could be cited of successful men whose start had been entirely different from what they intended when they emigrated. One man driven to an extreme took to washing windows, and found it most profitable, whilst another chopped up firewood and hawked it round. Both are now owners of their own businesses, whilst the men who went out with them, though possibly equally worthy, returned home and announced emigration to Canada a failure. In England probably more is heard of the failures than of the successes, the latter being too busy developing their new country to make much noise.

In travelling through Canada, one feels instinctively that the faith Canadians have in the future greatness of their country is not misplaced. Only by travelling through it, day after day, can its extent be dimly realised, and when one considers how comparatively little has been done, and yet how rapidly the country is opening up, a conviction is formed that the right men who go there to-day are the ones who will reap success to-morrow.

The writer was repeatedly assured that any man who was not afraid of work would do well there, and not only this, but that he would be welcomed and made at home.

It is important to remember that work means more to the Canadian than to the Englishman at home. This is easily accounted for; in the one case wages are high and labour is scarce, in the other, wages are low and labour is abundant. It follows that in Canada work is more strenuous, hours are longer, and specialisation is not so general.

Many a likely young fellow has spoiled his chances in Canada by obstinate adherence to methods of work which the Colonial condemns, and one of the first things necessary is to adopt the views of the Colony.

The importance of adaptability was insisted on in the previous article, and recent experience has shown that this can hardly be over-estimated. Owing to advertisements appearing in Canadian papers with the appendage that "no Englishman need apply," it is often considered that Canadians are opposed to English immigration. This is correct only to a small degree, and is due to their bitter experience of "remittance men," and to their deeply ingrained objection to the superior airs, often consciously or unconsciously, adopted when the English travel abroad. This is deeply to be regretted, for nothing is more likely to raise the Colonial ire than any indication, whether it is justified or not, that one is socially superior.

It cannot be too clearly emphasised that the sooner and the more thoroughly an emigrant adapts himself to the land and people, the greater will be his chances of success, and the sooner he will make friends and form those connections which go so far to make up for what he left at home.

In Western Canada and British Columbia, which places are at present advancing the most rapidly, an immigrant may consider he is well established when he has what is called "made good," and not before. This making good is equivalent to saying that a man has proved himself to be what he claims. Before a man has "made good," he may have a hard time, but once this is done he can be assured of much sympathy and help. But making good indicates more than that a man can do what he claims as regards his trade or profession, it indicates that he has a certain strength of character that will not be upset by trifles. For example, the men referred to who cleaned windows and sold firewood, would be considered to have made good, *i.e.*, shown grit, and triumphed over difficulties, whilst their less resourceful, and more despairing fellow emigrants had returned disappointed to England. It should be remembered that to take on any class of work whatever in Canada, where all men are socially equal, is in no sense degrading, nor is one likely to lose caste. In fact, men will often accept a post at a small salary in order to "make good" with a view to doubling, or even trebling, their salary in the first year. A case of this kind came under the writer's notice. Another point is that every man tries to save enough capital to start in business for himself, as this is considered an important point there.

This short article has been written mainly with a view to assisting those young fellows who have character, ability, and courage to emigrate if they think there are reasonable hopes of succeeding. There are others in the profession who may have done comparatively well, and the question arises as to whether emigration would be an advantage in their cases. There are certainly greater opportunities in Canada for using and investing capital than in England, and given that a man and family, who have become accustomed to the comforts of home life in England, are prepared to largely sacrifice these, there is no reason why they should not emigrate. Intelligent Canadians, with whom this question was discussed, considered that on the whole, if a man was doing well in England, the Dominion offered him personally

no advantages, but that, if he was willing to sacrifice his personal conveniences for the sake of the greater scope that would accrue to his offspring, he would do well to consider the question.

Finally, the writer would earnestly put forward a plea for the greater recognition of the importance of emigration.

The overcrowded state of the electrical profession calls for serious attention, and the possibilities of emigration in this respect have barely been realised or taken advantage of.

Even more important than this is the increasing necessity of English manufacturers to extend their business abroad if the electrical trade of England is to hold its own. Every home-trained electrical engineer who emigrates carries with him a knowledge and interest in home concerns, so that he becomes a factor for the good of British trade. Remembering the almost unlimited scope for electrical engineering in many parts of the world, and especially those countries which are only now being developed, it is to the interests of the electrical manufacturers in particular, and of the electrical profession in general, to encourage the emigration of the maximum number of suitable well-trained engineers.

So important, hopeful, and full of possibilities does the writer consider emigration to be, that he would strongly advocate the formation of a permanent sub-committee of the Institution of Electrical Engineers to deal with the subject in all its branches.

Such a committee, if formed, could count upon the support of the manufacturing interests, and that of all Colonial and many foreign Governments.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Batteries as Load Equalisers.

By a coincidence your issue of November 5th, 1909, drew reference to a circular recently issued by the Chloride Electrical Storage Co., Ltd., dealing with descriptions of their boosters and Chloride batteries in industrial works, while in another part of the same issue in an article on the design and operation of rolling mill motors, by Mr. Manktelow, several statements were made to the effect that batteries as load equalisers were very unsatisfactory.

It is evident that the author of the article is labouring under a misunderstanding as to the suitability of a storage battery for high-rate momentary discharges. Plates that are carefully designed for this class of service could readily handle discharges up to twice or even three times their one hour rating. In fact, it is not the danger of injury to the battery that limits the rate of discharge, but the drop in voltage, and the consequent cost of the boosting apparatus. By permitting the voltage to drop, and thus reducing the capacity of the boosting apparatus, the battery may be utilised up to three times its one hour rating with good practical results. This drop in bus voltage will produce no greater drop in speed than that required to utilise the energy of the fly-wheel, and need not be resorted to until the discharge rate exceeds a certain amount, whereas with a fly-wheel the speed must fall off for every unit of energy delivered.

It is not suggested that for all installations the battery booster would be superior to the fly-wheel, as the first cost of the fly-wheel is less than that of the battery, but it almost invariably is found that conditions arise in actual service which cannot be definitely predetermined, and which call for an output in KW.-hours far beyond the practical limits of the fly-wheel scheme, and the same battery which will meet the momentary peak conditions will have sufficient capacity to handle these exceptional loads, whereas the fly-wheel will be wholly inadequate. Reference to actual practice will be perhaps more convincing than mere general statements.

In the Gary plant of the Indiana Steel Co., the one 2,000-H.P. and six 1,000-H.P. motors which have been installed for operating the rolling mills, are provided with very heavy fly-wheels, and notwithstanding this fact a storage battery is required to handle the fluctuations in load, which would otherwise fall upon the generating machinery. In actual practice it is found that the operation of the mills is very much impaired, and the output in tons per hour is seriously reduced at the Gary plant when the battery is out of service.

Again, the results obtained from the operation of the first "Chloride" battery which was installed at the Carnegie Steel Co.'s, at Youngstown, Ohio, were so satisfactory that other batteries were installed in the different mills of the Carnegie Steel Co., in Pittsburg, in the Illinois Steel Co., in Chicago, and in the Lukens Iron and Steel Co., Coatesville, Pa.

We again repeat that we do not claim superiority of electrochemical storage over electromechanical storage *for all conditions*, but experience shows that electrochemical storage, with its admitted high efficiency, can be applied successfully beyond the limitations of electromechanical storage, and with sufficiently satisfactory results to warrant the somewhat higher initial first cost.

The Chloride Electrical Storage Co., Ltd.,
W. S. NAYLOR, *General Manager.*

Pendlebury, *December 22nd*, 1909.

The Industry and the Institution.

I received last week an invitation to be present at the Institution meeting, where the paper of Messrs. Lepine and Stelling was discussed. I declined that invitation on the ground that I did not think I could possibly discuss such a paper without contravening the rules of the Institution, which, I believe, preclude political opinions. A perusal of the reports available shows me that I need have had no such fear, and as I do not find my point of view exactly expressed in the discussion as reported, I should esteem it a favour if you would grant me the space necessary for such expression in your paper.

Messrs. Lepine and Stelling's paper sets up a comparison between Germany and this country, apparently to the disadvantage of this country, and offers as a reason the lack of enterprise of the English financiers and commercial leaders, saying: "If they were as enterprising and as successful as their German rivals English manufacturers supported as they are by the superiority of their products would not have to fear German competition in the open market." That, in my opinion, is entirely true. The question is: "Why are they not?" If it is admitted that our work technically is better than the German, how is it that the English financiers and commercial leaders fall so far behind their technical advisers? That Germany is ahead of us no one who is content to judge by results can deny. A country supporting four or five electrical companies, to say nothing of numerous smaller ones, aggregating in capital some £20,000,000 sterling and paying from 8 to 18 per cent. on such capital, is far ahead of us. That we are unable to even mildly imitate this is due to our fiscal policy, which began to act to our detriment at the very moment it was introduced.

As Mr. Rich very truly remarked in the discussion, "A financial artillery duel precedes all technical arrangements." If the electrical industry is to advance in this country, the very first essential is that profit should be made in order that more money may be found.

The reason why money is so very readily forthcoming for industrials in the leading protected countries is that they start off with a certain market. Another reason—the essential difference between Germany and this country—is that the vast wealth of England has been made. It is consequently in the hands of the most conservative class—the people who are looking for safe investments and not industrial speculations. Wealth under these conditions can go on increasing, and possibly does increase, as claimed by our Free Trade friends. In the younger countries, however, the wealth is in the process of making, is consequently being handled by those who are making it, which means the younger generation, which means industrial speculation. The term "industrial speculation" contains within it all the experimental work and commercial pioneer work which are so necessary to keep the engineering science and the engineering trade of the country in the forefront.

To come back to my point, if England—a country importing 250 millions annually more than its exports—were making money instead of living to a very large extent upon its income, income which is spent abroad, while our unemployed, to our lasting shame, are increasing every day, we should be doing all that the Germans are doing, all that the Americans are doing, and in my humble, but convinced, opinion, a little more. All that we want is a fair chance, and I am satisfied that we shall maintain the position which we have not yet lost, although it is being rapidly undermined.

A. B. Anderson.

I have read the leading article in your issue of the 24th inst. with the interest which is always aroused by clever polemic writings, and with the pleasure afforded by politely-veiled sarcasm, even when intended for oneself.

My object, however, is not to join in a controversy for the enjoyment of it, but to obtain amelioration of the conditions under which we are working in the electrical industry. I feel, in common with other performers, that we have work to do and duties to perform while the critics in the industry who have not the responsibility of performances are free to indulge in *Schadenfreude*.

Those who insist on regarding economic and legislative matters as political questions to be excluded from discussion of the electrical conditions, or to be discussed only superficially, do serious harm to the industry. These questions are at the root of our industrial problems, and their elimination or partial treatment precludes an exhaustive inquiry into the conditions. Moreover, those who take up this attitude are apparently forced into making contradictory statements—such as that the disabilities referred to are non-existent, and that they are due to lack of sound business principles, that they are due to absence of enterprise and to the greed of capitalists in fostering excessive competition. No good purpose whatever is served by general imputations of this kind, for although they may be intended to apply only to particular members, they amount to alternative indictments, incapable of proof, of entire industries and of all who are engaged therein.

The position I have taken up in regard to this matter is, I think, unequivocally expressed in the statement I recently made at the Institution, and in the letter I have written to the secretary of the Institution. I ask for a representative and authoritative organisation for the discussion of our troubles with a view to an agreement being arrived at as to the remedial measures to be adopted. One of the reasons why there is no such organisation is that many of us entertain the belief that the Institution is there to promote and defend our industrial interests, although I affirm (without the use of any invective) that the Institution has not adequately safeguarded our legislative and industrial interests in the past, and I have asked the Council to make a definite pronouncement on the question of whether these matters are within the recognised province of the Institution, so that we may know where we are. The reply of the secretary is that the question is receiving consideration. I, therefore, await the decision of the Council. For my own part I hope the Council will not take your view that "the ability of the Institution to confer the maximum benefit upon its members," is shown by its aloofness from questions which are deprecatingly called political, but which, as I have already shown, cause not only the material prosperity or adversity of the industry, but even the fructification or otherwise of scientific research.

E. Garcke.

Ditton House, Maidenhead,
December 26th, 1909.

Russian Development.—Russia is welcoming British enterprise in gold mining, railway building and other industrial undertakings. An interesting interview with M. Kokovtseff, the Russian Minister of Finance, appeared in the *Standard* on December 24th, in which the general question of British capital for Russia was discussed.

RESTRICTIVE COVENANTS.

All men of business who have occasion to employ clerks or assistants, are well aware of the necessity of inserting a restrictive clause in the agreement of service. Keen competition makes it difficult to make and keep a connection; and steps must be taken to prevent a discharged clerk or assistant drawing off the custom of his late master, or entering into direct competition with him. A case which was heard in the Chancery Division some months ago involved the discussion of an interesting point in relation to what are termed "covenants in restraint of trade." The decision was as follows:—The defendant covenanted not to practise as an architect or surveyor within a defined area for a certain number of years. It was held that he committed a breach of that covenant by acting as manager in a fixed area to another architect. He who is not a lawyer may wonder why there should be any doubt about a question of this kind. He may also fail to understand the meaning of the phrase "covenant in restraint of trade." It is necessary, therefore, to point out that, as a general rule, a covenant which binds a man not to practise his calling at all, is looked upon with suspicion. The reason is that if a man deliberately sells the right which all men have in a free country to the exercise of their calling, he deprives the public of the benefit of his skill and experience, while he abandons what may be his means of livelihood. A principle of law has, therefore, been evolved, having its origin in the famous case of Mitchell *v.* Reynolds, which was decided in 1712, that contracts in restraint of trade are void, and must not be enforced by the Courts. If an electrical engineer at the present day were to enter into a bond which prevented him from carrying on his business anywhere for the rest of his natural life, no Court of Justice would enforce its due performance.

But while contracts in total restraint of trade are void, it has become a well settled rule that if restriction is limited as to area, and there is "consideration" for the bargain, the goodwill of a business may be made the proper subject matter of a contract. And so the well-known "bond" into which the vendor of a business enters is recognised in, and will always be enforced and respected by, a Court of Justice. Were it otherwise, the sale of a connection would be rendered impossible, as nothing could operate to prevent the vendor from interfering with the practice which he himself had disposed of for a substantial sum of money. Similarly, unless an assistant or servant could be put under restriction, employment anywhere would be dangerous on any terms.

Such is the bare outline of a branch of law which is surrounded with many technicalities. Into these it is not our purpose to inquire at any length, but there are a few points which demand a further elucidation. It has been pointed out that the restriction must be limited as to space. It would be wholly unreasonable, for instance, to prevent an assistant from exercising his calling anywhere in the British Isles. Many cases have arisen in the Courts as to what is a reasonable limit. In Horner *v.* Graves (7 Bing. 735) it was held to be unreasonable to restrict a dentist from practising anywhere within 200 miles from York. On the other hand, to borrow an instance from the legal profession, a covenant preventing a solicitor from practising as such anywhere in England for 20 years has been held to be reasonable and capable of enforcement (Whittaker *v.* Howe, 3 Brs. 383). It follows, therefore, that in marking the border line, the Court will be influenced in a large measure by the nature of the business. The available means of communication are also important. By means of railways, telephones, &c., a practice can be extended over a much wider area at the present day than would have been possible at the close of the last century. That the Court is willing to enlarge the boundary in certain cases, even to the confines of the habitable globe, was clearly demonstrated in 1896, when world-wide restriction was placed upon the manufacture of a particular class of guns and armament. Although this case could never have any direct application to the electrical profession, yet it serves to show the elastic nature of rules by which the Court is governed in these matters.

With regard to time, there does not appear to be any restriction. Nevertheless, if a man binds himself not to practise for a limited period, the area of restriction may receive a slight extension. The rule by which the boundary should be determined was thus expressed in the case of Horner *v.* Graves, to which allusion has already been made:—

"The restraint must be only such as to afford a fair protection to the interests of the party in favour of whom it is given, and not so large as to interfere with the interests of the public."

The consideration—another essential feature of these contracts—is the next matter which deserves attention. And upon this point, so long as the Court is satisfied that there is a consideration which is not merely colourable, the contract will be enforced. The adequacy of the consideration is left entirely to the parties themselves. Instances could be cited without number to show what has been held as a reasonable consideration. In the case of Sainter *v.* Fergusson (7 C.B. 716) the engagement of the defendant as assistant was held to be sufficient consideration for an undertaking on his part not to practise within a radius of seven miles after the termination of his employment.

Having made an attempt to indicate the features which are essential to contracts in restraint of trade, we now propose to consider what constitutes a breach of such contract. In most contracts the covenant is in the following form: The vendor undertakes that he "will not at any time hereafter, directly or indirectly, and either alone or in partnership with or as assistant to any other person or persons, carry on the profession or business of, &c., within a certain area." A further clause prohibiting practice "in open competition" sometimes finds its way into the deed.

The question naturally arises, What constitutes practising? Most men—or their consciences—will be able to answer this question without difficulty, but doubtful points arise from time to time. In the case of Palmer *v.* Mallett (36 Ch. D. 411) it was decided that a person acting only as a salaried assistant was carrying on the profession of a surgeon, and that to do so was a breach of the covenant. In that case Lord Justice Cotton said: "Carrying on a trade implies to, my mind, that the person engaged in it is engaged in it *qua* trade—that is to say, as a trade producing profit or loss which is to be shared by him; and that is not the case if he is merely a salaried assistant. . . . I cannot come to the conclusion that a man is less carrying on the profession of a surgeon because he is doing so as assistant to someone else. 'Profession' is different from trade, and it is much more emphatic to my mind than if 'business' alone were here. When, as here, the words 'carrying on the business or profession of a surgeon' are merely used to denote what is done by a man acting as a surgeon, a man, in my opinion, acts as surgeon none the less because he is not the principal or engaged in the business as a partner, but is merely carrying it on as assistant to somebody else." It was the very case of Palmer *v* Mallett that was followed in the case under review, where Mr. Justice Warrington said: "Applying that to the present case, surely someone who was assisting as architect another, who was himself carrying on the profession of an architect, was himself carrying on the profession of architect as much as if he was acting as architect for a lay client."

Waste Electricity.—The *Daily Mirror* of December 18th published some ridiculous statements to the effect that, owing to the introduction of the metallic-filament lamp, the electricity supply companies are "producing very nearly twice as much current as is being used. Much of this surplus current must go to waste!" Further, "an experienced electrical engineer" is said to have told the *Mirror* "that the companies are turning out current that they cannot sell."

The appearance of arrant nonsense in the columns of the daily Press in connection with electrical matters is not uncommon; but to make an electrical engineer responsible for such stuff is really going too far.

PROCEEDINGS OF INSTITUTIONS.

Research on Metallic-Filament Lamps.

By F. H. Reakes Lavender, M.Sc., Student.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Birmingham, December 1st*, 1909.)

This research was undertaken in order to investigate the conditions of working as regards voltage, and efficiency and percentage drop in candle-power, giving the most economical life in the case of metallic-filament glow lamps, and to determine as far as possible the cost of illumination with this source of light.

It was considered desirable that the results should apply to metallic-filament lamps generally, and not to a special make. For this reason a number of lamps were obtained from six firms which were considered fairly representative of that industry in this country. The lamps were obtained direct from the makers, of 100 volts and 25 c.p. They had clear bulbs, and in most cases were marked to burn in any position. Six lamps of each kind were taken and run at six different voltages, namely, 95, 97·5, 100, 102·5, 105, and 107·5 volts. Thus there was one lamp of each make at each voltage, making 36 lamps in all.

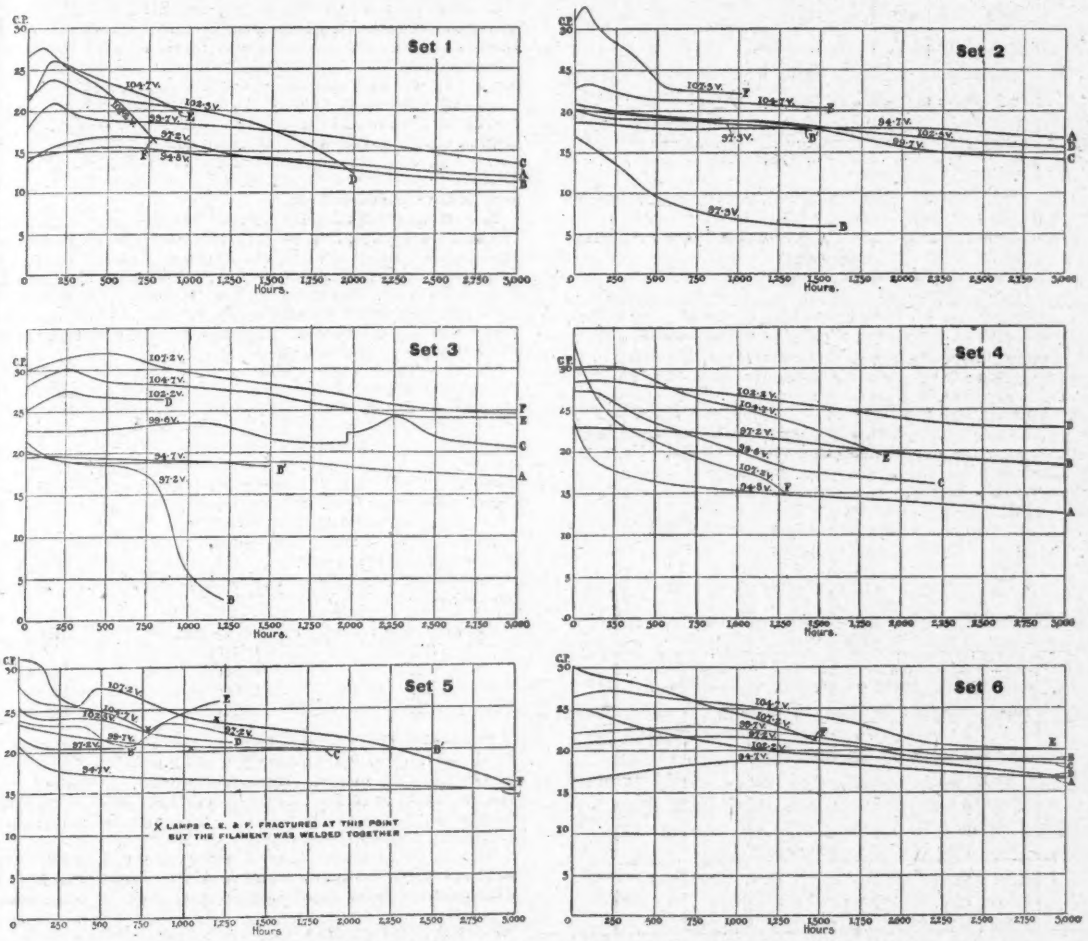


Fig. 1.—Life and C.P. Curves of Metallic-Filament Lamps

For the life tests the lamps were run continuously night and day, week ends included. In the daytime (about seven hours) power was obtained from the University power station, off the 110-volt lighting mains. At other times the load was switched over on to the 220-volt battery. The lamps were run as far as possible under the usual commercial conditions. No special automatic voltage regulation was used. The drop across the battery during the night was very small, and easily allowed for by slightly increasing the potential difference at the lamp terminals at the start. In the daytime the voltage had a limit of variation of 2 per cent. up and down for the most part. The lamps were taken out of their holders and into an adjoining room to be photometered twice a week.

For convenience a number has been assigned to each make of lamp, the voltage being indicated by a letter, as follows:—

Makes 1, 2, 3, 4, 5, 6.

Voltage	A means	95 volts	Voltage	D means	102·5 volts
"	B "	97·5 "	"	E "	105·0 "
"	C "	100·0 "	"	F "	107·5 "

Thus lamp No. 1 A is the one of make 1, run at 95 volts. Those of Set 1 are tantalum; the other sets are tungsten.

The candle-powers of all six lamps of a set are plotted on one sheet against the life in hours as abscissa. The curves shown (fig. 1) are the mean lines drawn through the points. The candle-hour curves (fig. 2) give the number of candle-hours obtained from the lamp for a given life. From the price of the lamp the "pence per candle-hour for lamp" curve is constructed. This shows the proportion of the total

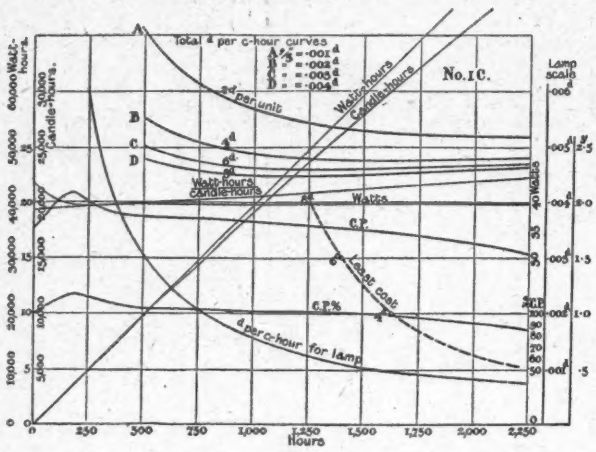


Fig. 2.—Results of Tests on a Tantalum Lamp at Normal Voltage.

cost which is due to the outlay on the lamp. These curves have been worked out on the latest list prices at the time of writing, which are as follows: Make No. 1, 2s. 6d.; the other makes, 3s. 6d. On the same sheets the consumption curves corresponding to the lamps are plotted; from these the watt-hour curves are obtained. The watt-hour curve, together with the candle-hour curve, gives the curve of watt-hours/candle-hours. This gives the average efficiency, and therefore, with a certain price of energy, the cost per candle-hour for any predermined length of life. From this curve, together with that of lamp cost, the "total pence per candle-hour" curves are plotted. This has been done for energy at 2d., 4d., 6d. and 8d. per unit. It was found best to plot them at four different scales, otherwise those at cheaper current would be unduly

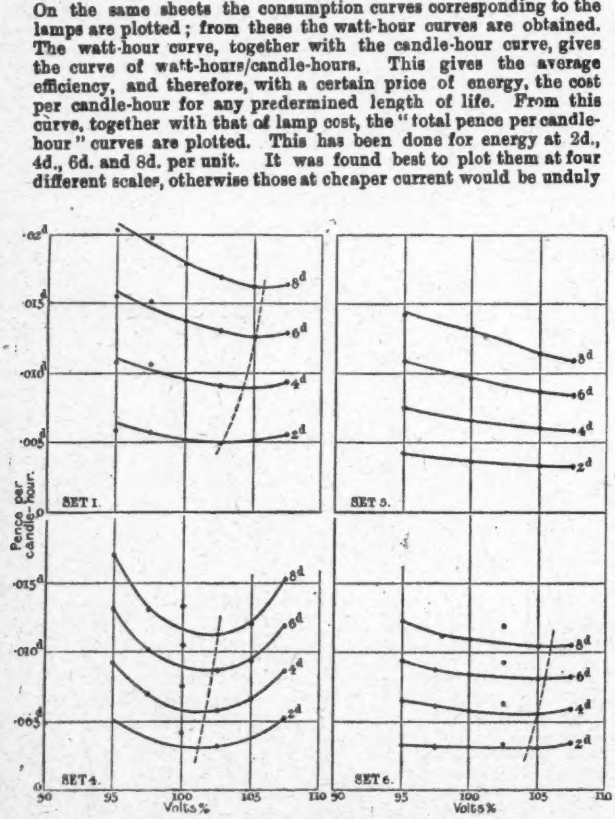


Fig. 3.—Total Cost of Light at Different Prices of Energy for Various Makes of Lamps.

flat. The scales have been marked on the sheets. When the lamp has been burning a sufficiently long time, the ordinates to these curves reach a minimum value; this gives the most economical life for the lamp. It happens in some cases that the lamp breaks before this point is reached. However, its absolute life may often be prolonged by welding the filament together, by shaking the lamp until the loose end comes in contact with another part, so closing the circuit. This means that it will be overrun to an extent depending on the length of the filament cut out. This is an advantage, since, even if the lamp does not last very long, yet for that period we are obtaining light at a higher efficiency and without any cost for the lamp, because it is a scrapped one we are using.

For example, lamps Nos. 5 C, 5 E and 5 F fractured at 600, 800 and 1,200 hours respectively, and after being joined again, burnt to 1,800, 1,200 and 2,900 hours respectively. In other cases the increase in life was not so great. Naturally much greater care has to be taken in handling such lamps, as the joint is very liable to become broken again. This, however, shows that the fragility of metallic-filament lamps is to some extent balanced by the possibility of mending broken ones. This does not apply to tantalum filaments, which, I understand, speedily fracture again after welding. Perhaps this is partly due to the shortness of the loops and consequent greater mechanical strain on the joint, and partly to the fact that their temperature is considerably lower than that of tungsten filaments.

The broken-line curves give the relation between the cost of energy in pence per unit and the useful life. They are obtained from the total cost curves. In fig. 3 are curves giving the relation between the least total cost of light (for lamp and energy) and the voltage for four typical cases. These have been constructed by taking the minimum points of the total-cost curves mentioned above. The broken lines on these sheets are drawn through the minimum points.

Considering the tantalum lamps, *i.e.*, Set 1 first, all the candle-power curves show a distinct rising at first and then a gradual fall, the slope of which depends on and increases with the voltage at which the lamp is run. In nearly all cases the actual life curves are very wavy, with alternate rising and falling of candle-power.

Two of the lamps, namely, 1A and 1B, were still burning when these results were collected. The useful life of a lamp, and the drop in candle-power which it is advisable to allow for a given voltage, depend on the cost of energy and the price of the lamp. The cheaper the energy, of course, the longer the life, and the greater the admissible drop.

Taking energy at 5d. per unit as an average price, and the lamp run at rated voltage, then it pays to throw the lamp away as soon as the candle-power has fallen to 3 per cent. below its original value. This result appears startling at first, considering the large initial cost of the lamp. However, by the time this point is reached the lamp has been burning for 1,500 hours at the best possible efficiency for the given potential difference at its terminals, so that the cost of the lamp per candle-hour has become small. In most cases the "total cost" curves are very flat near their minimum value, so that the exact time to scrap the lamp is not very clearly marked. When the lamps are run at a low voltage the efficiency curve rises very slowly, and the smashing point is not reached until the "lamp cost" curve has become fairly flat, which means a long economical life, for the candle-power is low but varies slowly. On the other hand, when run at a higher voltage the changes in the lamp take place more rapidly, the efficiency curve rises quicker, and consequently the economical life is shorter.

From the curves, fig. 3, it appears, as would be expected, that the dearer the energy the higher the potential difference at lamp terminals, and therefore the efficiency at which it pays to burn it:—

Price of energy.	Per cent. voltage.	Hours.
8d.	106·0	700
6d.	105·0	950
4d.	104·0	1,050
2d.	102·5	1,300

It appears that it would be good practice to overrun the lamps from 2 to 6 per cent., and for a life of 1,300 to 700 hours according to the price of energy. With energy at 4d. per unit the drop in candle-power from the initial giving the most economical life appears to be about 5 per cent. This is very much less than that commonly allowed in the case of carbon lamps.

Tungsten lamps are included in Sets 2, 3, 4, 5 and 6. Many of the remarks made on tantalum lamps apply equally well to these. The initial rise in candle-power mentioned in connection with tantalum lamps is in most cases not apparent. It occurs most markedly in Set 6. The candle-power curves, generally speaking, show a continual drop from the start. In many cases the drop is very rapid at first, and then becomes less and less so until they become almost horizontal. When this is so there is found to be very little blackening of the bulbs. The total-cost curves reproduced in fig. 3 all show the same characteristics as those for tantalum lamps.

These curves in the case of Set 3 show a continual drop without a minimum point. This is due to a very great improvement in the efficiency of the lamps at higher voltages without a corresponding shortness of absolute life or greater steepness of the life curves. The following lamps were still burning when these results were collected:—

Set 1.	Set 2.	Set 3.	Set 4.	Set 5.	Set 6.
A B	A B' C D	A C E F	A B D	A B	A B C D E

Collecting these together we get:—

Voltage	95·0 A	97·5 B	100·0 C	102·5 D	105·0 E	107·5 F
Number of lamps still burning.	6	5	3	3	2	1

From this it would seem that the increased potential difference has an effect on the absolute besides the useful life. The useful life of tungsten lamps is much longer than that of tantalums. If carelessly handled the absolute life would probably be shorter owing to the greater fragility of the filament. It may be noted that the area of bulb exposed to blackening is greater in the case of all the tungsten lamps tested than in the case of the tantalums. This would help to prolong the efficient life. Practically all the

blackening takes place in a belt opposite the filament, the pip end keeping clear.

The following table gives a comparison of the different makes. Below it are given for comparison some figures for carbon lamps

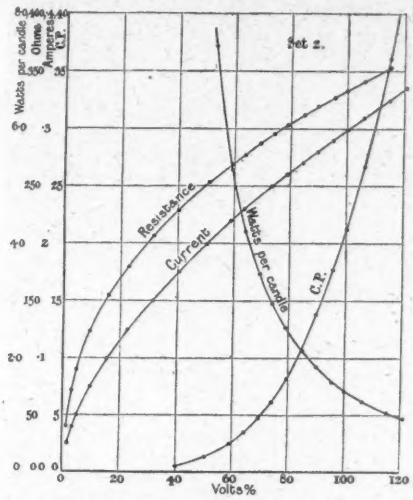


FIG. 4.—VARIATION OF CANDLE-POWER AND EFFICIENCY WITH VOLTAGE.

taken from Mr. Hirst's paper, read before this Institution, and reduced to English candle-power, and 9d. per lamp. The cost of energy has been taken at 4d. per unit :—

Lamp.	Initial candle-power.	Volts per cent.	Useful life. Hours.	Mean effi-ciency.	Candle-hours.	Cost per 1,000 candle-hours.		
						Re-newals.	Current.	Total.
Set 1 ...	21·50	105 0	970	1 87	22,200	1·35d.	7·50d.	8·85d.
2 ...	24 20	105·0	1,500	1·45	32,400	1·30d.	5·80d.	7·10d.
3 ...	30 00	107 5	2,300	1·29	67,464	0·64d.	5·16d.	5·80d.
4 ...	28 50	102 5	2,000	1 32	53,138	0·79d.	5·28d.	6·07d.
5 ...	31·20	107·5	1,900	1·34	47,500	0·88d.	5·36d.	6 24d.
6 ...	26·50	105 0	2,350	1·22	55,770	0·75d.	4 88d.	5 63d.
No. 1*...	15·10	100 0	1,000	4 94	14,560	0·619d.	19 75d.	20 369d.
2*...	14 95	100 0	1,000	4·06	14,400	0·628d.	16·25d.	16·878d.

* No. 1, 110-volt; No. 2, 200-volt, carbon lamp.

The duration of life is that giving the best economy. The actual life in some cases was much greater. The life curves show that many lamps were burning well at 3,000 hours. Unfortunately, I was not able to continue the tests further, or an even greater duration of life would probably have been obtained. The voltage is that which, according to the curve, gives the best economy.

From these tests it appears that the cost of lighting with tungsten lamps amounts to about 6·2d. per 1,000 candle-hours. If tantalum

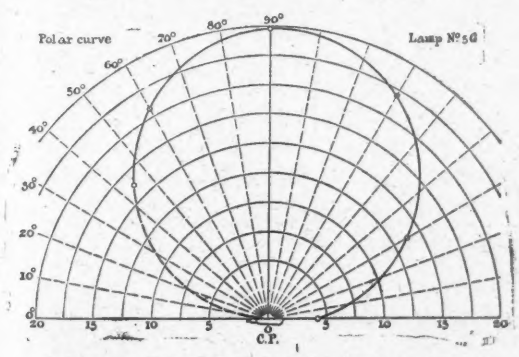


FIG. 5.—POLAR CURVE OF CANDLE-POWER.

lamps are used the cost is about 8·8d., or 42 per cent. more. When carbon lamps are used, according to the figures above quoted, the cost is about three times as much as for tungsten. In the case of metallic-filament lamps 85 per cent. of the cost is paid for the energy consumed, and 15 per cent. for the lamp itself, while with carbon lamps this latter item only amounts to 5 per cent. of the whole.

The tantalum lamps are much tougher than the tungsten ones, and are sometimes preferred on account of the agreeable colour of their light, which is not so white as that of the tungsten lamps.

In shop window lighting, &c., the lamps are often placed in close proximity to perishable goods. The outside temperature of the bulbs was therefore measured. The maximum temperatures, after 1,400 hours, were 95° C. for tantalum and 79° C. for tungsten (No. 4), 48° C. (No. 6).

Some tests were made in order to determine the dependence of the candle-power and efficiency on the voltage. A typical set of curves is given in fig. 4.

For a 3 per cent. variation of volts above and below the normal the average variation for metallic-filament lamps works out at 22 per cent.; the variation with carbon lamps is 50 per cent. more.

Some tests were also carried out in order to obtain the mean spherical candle-power. The lamps were run at rated voltage. When being photometered they were fixed in a stand which enabled them to be turned through a complete circle in planes perpendicular to and parallel with the filament. The following table gives the average figures obtained:—

A.	B.	C.	D.	$\frac{A.}{C}$	$\frac{D.}{C}$
Mean spherical C.P.	Mean hemispherical C.P.	Mean horizontal C.P.	Perpendicular C.P.		
17 6	18·6	22·7	4·0	0·78	0·18

The mean spherical candle-power is thus about 22 per cent. less than the mean horizontal candle-power, and the vertical candle-power is only 18 per cent. of the horizontal.

I have reproduced a representative polar curve in fig. 5.

Marine Propulsion by Electric Motors.

By H. A. MAVOR, M.Inst.C.E.

(*Abstract of paper read before the* INSTITUTION OF CIVIL ENGINEERS, *December 7th*, 1909.)

So long as reciprocating steam engines were the best attainable power generators, it was possible to correlate the speeds of generator and propeller so as to gain the best efficiency of each; but the steam turbine and the non-reversible internal-combustion engine introduced a new set of conditions.

Before the introduction of electric transmission the marine engineer had the more complete scientific data, and consequently the marine engine held the blue ribbon of economy which now belongs to the turbo-electric generator. Among the reasons for the higher efficiency of the land turbines are:—That the engineer on land is freer than is the marine engineer to adopt a suitable speed of revolution; that the land turbine runs at approximately constant speed for all loads, and can therefore be run on the governor, rendering easier the application of superheat and augmented vacuum; that on land it is possible to sub-divide the power-units to meet the conditions of varying load, and thus maintain at the smaller loads an efficiency not materially different from the efficiency at the full load of the system; that at sea, change of power is directly associated with change of speed, and the whole of the power units must always be in motion while the ship is in motion. The same engine has to run the ship at 10 knots and at 20 knots, although the power varies very widely between those limits. Also the high economy of power production on land associated with electric transmission is largely due to the possibility of exact measurement of power under all conditions of load, giving a complete knowledge of the effect of all changes in the apparatus or in the methods of working it.

The proposition here made is to provide an electric equipment intermediate between the prime mover and the propeller, extending the limits of practical economy in each by modifying the restrictions which the prime mover and propeller impose upon one another, and providing that the prime mover may operate at or near the constant speed required for the attainment of maximum efficiency and full power, and that the power expended in driving machinery not required for work is reduced to a minimum or entirely eliminated. At full power all the elements of the generating plant are in full operation and the whole power resources can be concentrated on driving the ship. When full power is not required the generating plant may be shut down in sections.

To accomplish these ends special motors have been designed which give the necessary changes of speed and direction and permit of the advantageous combination or elimination of the power generators. These motors involve no new electrical principle, but simply mechanical adaptation of well-known electrical designs. Alternating current alone is available for the purpose in question, and normal motors have, therefore, a fixed speed of rotation which is a simple multiple of the generator speed.

Two methods of speed change are proposed, each associated with a new form of motor.

The principle of operation of the "spinner" motor is that an ordinary normal motor driving the propeller at a fixed speed, with the shaft and propeller directly connected, is so arranged as to be rotatable as a whole about the propeller-shaft axis. This rotation is accomplished by a second motor concentrically arranged outside the first, so that the main motor system may be rotated in either direction—again at a fixed speed which is a simple multiple of the generator speed—and the speed of rotation of the propeller shaft and of the propeller in the water is the algebraic sum of the rotation of the main motor and of the rotation imposed upon it by the auxiliary motor.

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As both motors are reversible it will be seen that in each direction there are three speeds:—

1. The speed of the main motor system; the middle speed.
2. The speed of the main motor system minus the speed of the auxiliary motor system; the low speed.
3. The speed of the main motor system plus the speed of the auxiliary motor system; the full speed.

The combination may be designed for any three-speed ratios, such as 1, 2, 3; 2, 3, 4, &c. Any intermediate speeds required are attainable by adjustment of the turbine or engine-governor, which can be operated economically through a range down to about 75 per cent. of full speed. The same method is applicable to non-reversible internal combustion engines.

The "Multiple" motor is an ordinary squirrel-cage induction motor in all respects, except that its stator is wound with two or more independent electric circuits, each associated with a separate source of supply of energy.

For example, the motor may be fed from two sources of supply at 25 and 50 periods respectively, the motor windings being for 46 and 92 poles. At full power and speed, both windings are in operation under their most advantageous conditions; each of these windings results in a synchronous speed of 66 revolutions per minute. When the 25-period current is supplied to the 92-pole winding, the speed is 33 revolutions per minute.

Each of these motors permits of one or more generators being used together in the same mechanical system without electrical connections or synchronising devices.

The author then goes on to discuss the application of electric propulsion to certain definite types of ship, and also gives diagrams illustrating the saving in space obtained. The examples worked out are as follows:—

1. In a cargo vessel of 840 shaft-H.P., the normal reciprocating engine equipment with a single screw would weigh 570 tons for engines, boiler and fuel. The electrical equipment, consisting of three oil engines, three motors and three propellers, would weigh only 270 tons, including fuel. Further, with coal at 20s. per ton, and oil at 40s. per ton, the saving in fuel cost on a total of £17 would be £5 6s. per day at full power.

2. In a similar cargo vessel gas engines might be used. Taking an equipment of 770 shaft-H.P., and using three gas engines and one multiple motor, the respective weights of the normal and proposed equipments would be 446 tons and 229 tons. The consumption of fuel shows an equally favourable comparison.

3. A third cargo vessel, but of 1,030 shaft-H.P., is worked out for the purpose of illustrating the application of steam turbines to the multiple motor. One plant drives the ship under normal conditions: extra power is supplied by a small turbo-generator, and is used to keep up the ship's speed in heavy or contrary weather.

4. On a passenger vessel of, say, 16,200 shaft-H.P., the electrical equipment permits of a sub-division of the plant, so that at ship speeds lower than the maximum only part may be run, and that at full power. This advantage is gained without loss in full power economy, and without additional complication.

Notes on Methods and Practice in the German Electrical Industry.

By L. J. Lepine and A. R. Stelling, Dipl.Ing., Students.

(*Discussion at the* Institution of Electrical Engineers, *Manchester, December 14th*, 1909.)

Mr. J. S. Peck thought the most valuable part of the paper was that dealing with the financial relations between the manufacturers and the banks. Many opportunities had been lost by British firms to Germany, simply because the Germans made money to put into the company to help finances. The same arrangement existed, to a lesser degree, in America. He noticed in a paper a paragraph regarding a certain railway about to be completed: "Part of the road has been financed by German interests, and the equipment will, of course, be manufactured in Germany. The other part of the road was financed by a British financier, and it is hoped that a considerable portion of the equipment will be manufactured in Great Britain." There appeared to be more co-operation in Germany among the manufacturers than there was in this country; in fact, there was very little here, and he would like to see a little forced co-operation in the shape of a protective tariff. He understood that at the A.E.G. works, part of the time they had three eight-hour shifts per day. As regarded the statement as to the finish of the German machines being slovenly, he thought it was true in general, but he had seen some German machines that were beautifully finished. They could teach us nothing with regard to high-voltage windings. The special form of field-winding for turbo-generators with "butt" joints had been tried elsewhere, but without success; in fact, it gave a great deal of trouble.

Mr. Gregory considered that the rule of forbidding the draughtsman to enter the shops was peculiar. A draughtsman should be acquainted with the general design of the machinery he was connected with, and it did not seem conducive to the firm's interest to keep him away from the process of manufacture.

Mr. T. L. Miller said that the methods by which the German firms were financed and the mode of dealing with the staff in countries outside Europe, had a great influence on the manner in which Continental firms obtained large contracts outside their own country, and in competition with British manufacturers. Most of the Continental firms had good technical staffs at their branches, who were able to go into the whole matter on the spot, and close the bargain there and then. With most of the British firms it was necessary to write home before anything could be done. Then, again, the financial system enabled the Continental firms to take greater risks than was possible in the case of the British manufacturer. It was not superior technical education and design, so much as the financial backing, and the type of agents they had abroad, by which success was attained. The closer the connection between the drawing office and the shop, the better. A draughtsman ought not only to be kept in touch with the carrying-out of the work, he should also be allowed to get out the cost of the work, and the value of the material and labour upon it, and to check his estimates with the actual results which had been obtained in the works. The more the men in the drawing office know about costing, the better for the employers. With regard to works management, a firm of high-speed engine builders had four Committees dealing with the whole of the production, viz.:—Designs, Estimating, Works, and Sales Committees, and there were certain men who were on the whole of the Committees. Supposing a new design was got out, it was first submitted to the Designs Committee, who criticised it. On that Committee they had some of the foremen, and also representatives of the Estimates, Works, and Sales Committees. From there it went to the Works Committee, who considered the question from the works point of view; from there to the Estimating Committee, who drew up the cost, and then the Sales Committee considered whether the thing would sell. An arrangement like that was to his mind one of the best methods that could be adopted. Where there was a large variety of different classes of work, it was well for the heads of various departments to collaborate from time to time with those in the office, and pass the designs before they went into the works.

Mr. J. Frith said that draughtsmen should be forbidden to stay in the office rather than that they should be forbidden to go into the shops. He would like to know whether in the curves comparing English and German machines, allowance had been made for the lower temperature rise and larger overload capacity of the English machines, also if the commutator copper was included in the weight of the active copper. In the $D^2 L$ formula the "n" seemed out of place, and the 10^{-4} seemed to indicate mm. not cm.

Mr. Faye Hansen said he had worked in both countries, and agreed that the reason of the German success was not to be sought in better design and workmanship, or in tariff conditions. There were quite a number of smaller firms having capitals of from £100,000 to £500,000, which were doing important work in generators and motors as well as in specialities. He thought the continued existence of these firms was one of the reasons why trusts in Germany had not been detrimental to the German electrical trade, as competition in all classes of work had prevented stagnation. Regarding draughtmen not being allowed in the shops, it was not true of the shops he was acquainted with, which included two of those mentioned in the paper. The hours in the A.E.G. works four years ago were six to two, and two to ten; but when busy, a night shift from ten to six was worked. He had noticed in this country that if rush jobs were going through the shops, the cost of labour usually came out less than normally, notwithstanding overtime rates, which proved that ordinarily workmen were not working up to their full capacity. He had not noticed the same in Germany, and believed that the Trade Union policy of restricting the output of each man was very injurious to the industry. Wages in Germany four years ago were higher than the figures mentioned in the paper. Most of the work was done on piecework, or on a bonus system, and the wages of skilled workmen were more like 50s. than 30s. German firms were quite willing to alter their designs if an important order could thereby be obtained. There were very few consulting engineers in Germany, and it was, therefore, very seldom that firms were pressed to deviate from their standard design. The different wishes of consulting engineers were increasing the cost of English electrical machinery all through by at least 5 per cent., as a larger technical and correspondence staff was required for the same output. It would certainly give a big impetus to the industry if the consulting practice could be restricted to really eminent and broad-minded engineers.

Mr. R. B. Slacke stated that the average price paid per head in Germany for skilled and unskilled labour was about 6d. per hour. That was about the same average price as in this country. The skilled erectors got about 15s. per day, which was about the same as English erectors got when working on the Continent. There was no doubt that branch offices should be more efficient than agents, and principals were generally more willing to keep their branch offices fully posted as to progress than their agents. It was for this reason that it was not always the agent's fault if he was not as efficient as he might be.

Mr. H. W. Wilson, when in Germany, was struck with the good discipline which prevailed, and also the comparatively small amount of work turned out per man. Men worked steadily but not very hard. The hours of work were more, about 60 hours per week, and the wages about 35s., which was practically the same price as paid in England. Female labour in Germany was generally more highly paid than here. In the winding department the operatives got about 15 marks per week. In the A.E.G. works they reckoned to have one skilled man to every 10 workmen. The technical men were paid very badly considering their qualifications. He came to the conclusion that German manufacturers could not be producing much more cheaply than ourselves, but owing to the increased output the establishment charges were reduced. The great advantage of the German industry lay in its financial backing. There was no doubt that if the English electrical industry could obtain similar financial support, the outside markets would be a very much less serious matter than at the present time. Electrical manufacturers would never make money either with or without Tariff Reform unless the number of firms were reduced. If a combination of firms in this country were to adopt the policy of generally sending

out thoroughly qualified technical men who knew the conditions of the country, there would be a chance of obtaining some of the large orders.

Dr. F. H. Bowman thought the superiority in German trade arose from three things—viz., their sales departments abroad were better than our own, they had greater financial facilities, and they worked longer hours. He had been through German workshops, and the thing that struck him was the superior organisation, and that the works were kept cleaner; but a great deal of their work would not pass in England.

Mr. W. Cramp said the authors pointing to the dividend "earned" said that the state of the industry in Germany was satisfactory. From whose point of view was it satisfactory? Although it might be reasonable for an ordinary manufacturing firm to pay a dividend upon its capital, he did not think 12 per cent. or 18 per cent. was reasonable from a purchaser's point of view, unless there was some very special reason why such a dividend should be paid. It seemed to him that those dividends pointed to the existence of a sort of combination which we in this country should try to avoid, especially when, as in this case, they did not go hand in hand with relatively higher wages. With respect to the curves, the ratios of total active iron divided by total active copper, and of armature iron divided by armature copper, which were given for English and for German practice respectively, were not such as would, in his opinion, lead to curves shaped as these curves were; for if the above ratios were plotted against KW., it would be found that the curves of English and German practice crossed in some cases twice. It was said that it was difficult for us to export to Germany on account of the tariff against machinery and finished articles in general. Some few weeks ago he visited the Morganite Co.'s works in London, which made carbon brushes, and the manager told him that, if it had not been for the foreign demand for these brushes, they would have been compelled to give up making them. He mentioned that, of the brushes turned out, 1 million were going to Germany annually, to the very firms mentioned in the paper. On inquiring the reason, he was told that it was because the full technical data supplied for every quality of brush were much appreciated, and uniform results could be relied on. The English manufacturer was too slow to take advantage of this, and so continued to buy his brushes abroad. He had come across the "Kollonnen" system of labour in the textile trades. Although it looked satisfactory from the manager's point of view, it was, in his opinion, a most insidious and dangerous practice, which led very quickly to sweating.

Mr. Thomas said the system mentioned by Mr. Cramp was not in use in Germany. It was only applied to machine shops, and not to the erection of installations. It had been stated that wages were slightly less than in this country, but the cost of living had also to be considered. It was the organisation of these works which put them on the good basis they were on. The finish of German machines was generally reckoned to be quite equal to any. There were a great many small German firms who specialised in small things, such as arc lamps, switches, &c.

Mr. Adamson said that one of the American Societies of Electrical Engineers had a publicity department, which laid interesting facts concerning their industry before the general public. He thought it would be to the advantage of electrical engineers if their Institution took some steps to inspire the confidence of English financiers in the particular work its members were interested in. It was difficult to get money from the bank, but some trades were more favoured in this respect than others, and he thought it was because bankers were better informed. There was no difficulty in raising money for building Lancashire cotton mills.

Mr. T. H. M. Swinburne said that, apart from all questions of financial backing and tariff, much of the success seemed to be due to the fact that whenever a German firm wished to compete in this country, it invariably employed English engineers to exploit its interests in the first instance; then, when a connection was established, the Englishmen were replaced by Germans, with the usual results. Taking the case of other countries in the South of Europe, where English and German machinery were placed on the same basis as regards tariff, instances had arisen in which the preference had been given to English machinery, even when it cost 10 per cent. more than German, particularly in the case of textile work. There was no doubt as to the Germans being willing to send in tenders; but any departure from the standard specification invariably entailed additional expense, and it was quite another matter as to whether the requirements were actually met. If the tariff were reformed in this country the results would doubtless be very different.

The Chairman (Mr. S. J. Watson) said the very intimate relationship between commercial undertakings and the banks undoubtedly tended to help forward the carrying out of large schemes as the opportunity offered, but during times of trade depression trouble might occur. If a firm was paying 18 per cent., it was an easy matter to set aside a portion of the profits for scientific investigation, but unfortunately in this country there was not enough profit to allow for this.

Mr. A. E. Stelling, in reply, said he thought that the key-note of the whole system of trade abroad was organisation and the question of having proper staffs and competent agents. There was no doubt that combinations like those of the large German firms were more successful than the English firms, because they represented so many branches of the industry. That was particularly noticeable in the case of China, where one German firm had very large showrooms, showing all their manufactures and had a staff of 14 Europeans. He thought the good work which the German agents were doing could only be obtained on our part by a combination of English firms to set up a large show-room abroad, with competent agents to show the things they manufactured. The firms should be thoroughly organised and in touch with branch offices, which should be organised so that they would be capable of attending to anything that might come forward. With regard to impregnation, this was always done in vacuo, in some cases with varnish and in others with bituminous compound. He quite agreed that draughtsmen should be allowed to go into the shops, but he could not agree with Mr. Miller that so much latitude should be allowed the draughtsman. With regard to the organisation of works, in some firms the letters were signed by two men—one a technical man and the other a commercial man. The "active copper" was, of course, armature copper. The small letter "n" was in its right place, it represented the most efficient average speed in R.P.M. of the respective sizes of machines given in the tables; $D^2 l n$/KW. was a formula used by Profs. Arnold and Kapp for purposes of comparison, but the authors had given it what they considered to be a commercial value by altering it to $D^2 l n$/KW. at 1,000 R.P.M.; KW. at 1,000 R.P.M. limited the "standard size" of machines which would be offered. There were a good many small firms in Germany mostly manufacturing switches and instruments; a good many of these for a long time had not paid any dividends, and they were practically absorbed by the large firms. The standard rate of wages was lower than in England, except for certain classes of female labour. Erectors abroad were all paid the same wages, whether they were German, American or English. All the reports of the large companies and of the banks stated that adverse legislation had caused a diminishing business in certain branches, but, at the same time, the four large firms mentioned in the paper paid a dividend 1 per cent. higher this year than they paid last year. If the trade was decreasing at home, it must be increasing abroad. These German firms did insist on their specifications. If trade was so good as to warrant double shifts, he thought England ought to have a look in too. As to the financing of small municipal undertakings, the Council could borrow money on the plant to be erected, and with this money and the money the manufacturing firm put in, the plant was set up. The great advantage of that was that the manufacturing firm would supply the machinery and superintend the running, and the bank would take care of the financial side and of the accounts. As time went on, the town had power to repay the loan from the banks.

Institution of Mining Electrical Engineers.

The inaugural meeting of the Institution of Mining Electrical Engineers was held at the Midland Hotel, Manchester, on Friday, the 17th inst. The list of officers elected for the coming session is as follows:—

President, Mr. Wm. Maurice; Vice-Presidents, Mr. W. C. Mountain and Prof. W. Robinson; Hon. Treasurer and President of Finance Committee, Mr. A. M. C. Field, Newcastle; Hon. Editor of *Transactions*, Mr. J. H. C. Brooking; Hon. Secretaries, Messrs. Saunders, Derby. Two hon. members had been elected by the Council, viz.:—Mr. J. Glynn Williams, Whitehaven, the founder of the Institution; and Mr. Robt. Nelson, H.M. Electrical Inspector of Mines. The meeting elected Messrs. E. J. Dryhurst and Mr. J. Kirkby as auditors. Mr. Wm. Maurice then read his presidential address.

He first gave a brief account of the origin and development of the new Institution, which took its rise in a leading article in the Electrical Review on December 11th, 1908, followed by letters from various correspondents; in February last Mr. J. Glynn Williams, of Whitehaven, drew up a set of rules, and on April 24th a meeting was held at which it was decided to form a society, commencing with 50 members—a number which was quickly trebled. Mr. Williams was elected the first honorary member. The new institution was neither an offshoot nor a rival of any existing corporate body; it was new in conception, for its memorandum of association contained features never previously embodied in the design of any technical society, and new in title, for the electrical engineer possessed of special experience in the uses of electricity in mines was only just coming into existence.

Twenty years ago there were only three or four electric power installations in the mines of this country, and only 42 mines provided with the electric light, while to-day practically every colliery in the country had its own electric generating plant, and all classes of colliery workmen derived incalculable benefits from the use of electrical methods, which tended to increase their wages, while relieving them of physical labour. The exchange of manual for mechanical labour always increased the total volume of employment, and from a sociological point of view the change was always in the upward direction.

A very much higher standard of attainment was now demanded of the colliery manager by the changed conditions of the times, and it was expected that the next Mines Act would make a clean sweep of the existing system of appointing managers. Attention was drawn to the provisions of the Coal Mines Regulation Act, whereby every person found guilty of offences against the Act was made liable to punishment. The manager and under-manager were primarily responsible before the law for enforcing the regulations, and the engineer, electrician and other officials were responsible to them. The extended application of machinery and the adoption of scientific methods of working demanded technical qualifications for the under-manager, which a few years ago were thought good enough for a manager. The engineer and electrician were accounted of little importance when the 1887 Act was drafted, being referred to only under the vague title of "competent persons." Both wer undoubtedly destined to become mining electrical engineers, and

they should seek to understand each other at this new starting point. The colliery engineer must necessarily possess an intimate knowledge of his plant, but electrical work in many cases came too late in life for him to acquire familiarity with it, and the position called for the exercise of tact and judgment on the part of both the engineer and the electrician, for there must inevitably be occasional slight collisions of authority, overlapping of responsibility, and so on. Generally speaking, the colliery engineer of to-day was not an electrician, and the colliery electrician was not an engineer; but the new conditions demanded that each should have a competent knowledge of both mechanical and electrical engineering. The same goal would then be open to both. Measures should be taken to improve the position of the engineer, and the colliery electrician should be made responsible for the constant maintenance of all parts of the electrical installation in such condition as would normally suffice for the prevention of accidents. Colliery engineers were eligible for membership, and the colliery manager would be a valued member of the Institution, which also profited by the support of many well-known electrical experts. The constitution had been framed on a broad and generous basis, which provided that no class of official or member of a colliery staff should be inadmissible; but there would be a distinct class of diploma members, who were, or had been, actively engaged in the care or management of mining electrical installations, and had passed the Institution's examination in that subject, and who would eventually form the premier class of the Institution. The first object of the Institution, then, was to establish a professional class of mining electrical engineers, by considering means to minimise the risk in the application of electricity to mining, promoting the adoption of approved methods, and extending the experience and elevating the status of the members. It had been arranged that the papers and proceedings should be published in a weekly technical journal of high standing and circulated to all the members, instead of publishing "Transactions." A technical newspaper was, in the widest sense, a living library, and if one had any claim whatever to be a technical man, one must read the principal journal or journals relating to his business. A purely electrical journal had not been chosen, because the Institution had to deal only with the mining applications of electricity, from the mining point of view.

A disastrous explosion which recently occurred had been by some attributed to an electrical origin, and the main business of the Institution during its first session would be to inquire into the causes of, and means of preventing, accidents arising from the use of electricity in mines. The safety with which electricity could be used depended primarily on character; out of 48 accidents from shock between 1903 and 1909, only two were unavoidable, and of 19 ignitions of fire damp, only 1 was classed as an "accident," unsuitable apparatus and neglect being in most cases responsible. Accidents happened solely from want of order, cleanliness and common care; a little elementary technical knowledge, associated with intelligent application, would work wonders in the prevention of accidents. The true function of the engineer was to prevent rather than to repair breakdowns, and to lessen waste due to inefficiency. "The central passion of all men of true ability was to do their work well," and the problem of raising the efficiency of themselves and their surroundings was the most important object of their membership. That object was explicitly indicated, for the first time on record, in the memorandum of association. The future of the Institution must inevitably depend upon the collective character and ability of its members; if they wished it to grow and flourish, they must give loyal support to their leader, and, by raising the Institution, elevate their own status.

Proposing a vote of thanks to the President, Mr. W. C. Mountain said that as far as the mining industry was concerned, electrical machinery had suffered from inattention due to want of knowledge, and accidents with electrical machinery had frightened some of the proprietors, but in his opinion electricity was the safest thing to be used in mining operations, if properly looked after and given proper attention.

The title of the Institution had been criticised by some people, and after some discussion, it was resolved to defer the question.

A dinner was afterwards held, at which the President presided. After the loyal toast, Prof. Thornton proposed "The Institution of Mining Electrical Engineers," and said that in his opinion electricity when properly used, and properly attended to, was the best and safest thing that could be used in mines. The object of the Institution was to go into the question of mining electrical machinery, and make the risks as light as possible. The President, in reply, referred to the question of the title, and said that they were willing as far as possible to meet the wishes of other Institutions without detracting from their own position. There was no other society likely to injure them unless it were the National Association of Colliery Managers, and he thought they would have the support of that Association.

Mr. G. H. Winstanley proposed the toast of "The Mining Industry," to which Mr. Ritson and Mr. Halliday replied.

Mr. J. H. C. Brooking proposed "The President of the Institution," and Mr. Maurice, in replying, said that they were not endeavouring to make their Institution a highly technical organisation, but an educative one which would work for the managers and owners of collieries, and would be of great service to the mining industry generally.

Pig-Iron.—The output of pig-iron in Great Britain for the first half of 1909 was 4,715,679 tons, an increase of 61,690 over the previous half-year.

LEGAL.

The Electrical Co., Ltd., *v.* Oliver H. Thomas, Son and Co., Ltd.

(*Continued from page* 1015.)

Further cross-examined, Mr. Stottner said that the reason why plaintiffs entered into the agreement to unwater the mine after the flooding in June was, first, to avoid litigation, and secondly, because they had no desire that it should be spread about broadcast that the Electrical Co. had supplied a plant which was not satisfactory.

Mr. Williams, K.C., for the defence: Defendants were threatening you, were they not, and declaring that they had heavy claims against you?—Yes.

And your idea was that if you got in the first blow by issuing your writ, it might have the effect of stopping litigation?—Witness denied that this was so. Plaintiffs issued their writ simply to enforce payment for the plant. It was an automatic method. If a customer did not pay he was threatened from the counting house. If that did not bring about the desired result, then a writ was issued. Witness admitted that the plaintiffs supplied defendants with a plant which did not, to a certain extent, do the work required of it.

You contracted in 1905 to supply machinery capable of unwatering this mine, and yet in November, 1907—two years afterwards—the mine was still unwatered?—I could not say how long it was.

On Thursday, December 21st, Mr. Stottner was cross-examined by Mr. Williams for the defence, and, in answer to Counsel, said that about March, 1908, a Mr. Flood came on the scene as directing engineer, and he wrote several letters pointing out defects. Witness wrote and said that unless they received certain pipe columns which defendants had undertaken to supply, they would take no responsibility for anything which might occur. At that time the delivery pipes for the pumps, which were part of defendants' old plant, were in a very defective condition. Witness admitted that one of his people had suggested that a Worthington pump, which had been used in the mine, could be passed off as nearly new if it had a coat of varnish and some repairs. Witness added, however, that no one would buy such a pump without first properly examining it.

The Official Referee: I suppose this is a sample of what you would call "commercial diplomacy"?—Witness explained that the pump was one which had been taken to the mine when the plaintiffs were engaged in unwatering it.

Referring to a certain part of the work which plaintiffs were seeking to charge defendants with, Counsel asked witness if he really thought plaintiffs were entitled to make such a charge?—When the water was got out and they came to discuss terms it was thought that Mr. Thomas would meet them.

Examined as to certain charges, amounting to about £280, for work done in November for unwatering the mine, Witness said the labour which was charged for between July and November was incurred in unwatering the mine.

Counsel: Your letter of June 21st was to the effect that you would supply labour for unwatering the mine?—Witness agreed, and said that the mine was unwatered several times, but unfortunately it got filled up again.

Do you suggest that you should be paid for your unsuccessful attempts?—I think we should be paid in accordance with the agreement.

The Official Referee: The agreement does not say that you are to be paid if you fail to unwater the mine, and you admit you had not done this in November?—Witness eventually admitted that the unwatering was not carried out, and that defendants ought not to have been charged for it.

Mr. Williams: I thought you would agree with me in time.

Questioned as to the difficulty experienced at one time to get labour in the Lyuvi Valley, Witness declared that plaintiffs' men were "in a frenzy to get away from the mine." "They declared," said Witness, "that if the work did not stop soon they would run away, commit suicide, or something."

Mr. Williams: Why was that?—Because they were sick and tired of the whole job, and the work was very strenuous.

The Official Referee adjourned the hearing until after the Christmas vacation.

Shaw *v.* Stoke-on-Trent Pure Ice and Cold Storage Co., Ltd.

At the Hanley County Court, the week before last, plaintiff, John Shaw, owner of a dwelling house, 3, Ashford Street, Shelton, sought an injunction to restrain defendants from using or working in their premises any electric motor or other engine or machinery in such a manner as to interfere, by reason of the vibration and noise, with the plaintiff's enjoyment of the premises, or in any way to create a nuisance to plaintiff or injury to his premises. The company, it was stated, had a 40-h.p. electric motor, driving an ammonia compressor, and there were smaller motors driving fans. Plaintiff complained of the noise, and added that the whole house was in a tremble. Defendants said that there was no nuisance, but that, if there were, it was so intermittent that it might be disregarded. After hearing a certain amount of evidence, his Honour said that he would visit the house and the works before giving judgment (on January 12th), but he asked if it were not possible for some arrangement to be arrived at.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Automatic Tumbler Switch.

An automatic tumbler switch, which is claimed to be the smallest circuit-breaker extant, has been designed and patented by Mr. C. W. Denny, of 2, Pembroke Cottages, Edwardes Square, Kensington, W. We illustrate in the accompanying figure this automatic switch and wall-box combined, suitable for use on a conduit system.

The object of the switch is to eliminate as far as possible the use of fuses for small power and lighting circuits, and, consequently, to get rid of the trouble and inconvenience caused in replacing blown fuses. The switch is admirably adapted for controlling lights, either from a distribution board or from separate points. In the former case the distribution board is fitted either with D.P. automatic tumbler switches or with S.P. automatic tumbler switches and

Fig. 1.—"Denny" Automatic Tumbler Switch.

S.P. fuses, the fuses being, of course, rated about 50 per cent. above the load at which the switches are set to operate. In either case the size, and consequently the cost, of the distribution board is considerably reduced, and greater efficiency results. If the switches are used at different points of a building, a small distribution board is used, containing S P. automatic switches or fuses, as the case may be. If fuses are used, they are rated above the capacity of the switches, as mentioned above; in fact, with S.P. fuses one fuse can be used for several switches, and it should be preferably of the magazine type, thereby greatly hastening the restoration of current to a circuit.

Cooking Demonstrations.

An interesting series of demonstrations of electric cooking recently took place at the Le Radiant, Ltd., 83, Mortimer Street, London, W., their new patent electric ovens being used; among

Fig. 2.—"Le Radiant" Oven, 1910½ Model, No. 2.

those present were engineers and representatives from many electrical companies and corporations. Special watt and watt-hour meters were installed for the purpose.

On the 15th inst. the following were cooked:—6 lb. of beef and Yorkshire pudding; a large fowl; potatoes and cauliflower; a 3-lb. apple pie; cheese cakes and wine biscuits. The time occupied was one hour and a quarter, and the amount of energy consumed was 4½ units.

On the 16th inst. the following menu was cooked:—Leg of mutton, 7 lb.; large fowl; apple pie; French pastries; fried sole, and boiled potatoes. The time taken was one and a half hours and the energy consumed was 5 units.

The chefs and others present agreed that the results were excellent, and far superior to those obtained from either gas stoves or coal ranges, the dishes being very tender and of excellent flavour.

We described the "Popular" Le Radiant stove in our issue of July 9th, p. 75; since then the design has been improved, and we illustrate the 1910 model, No. 2, herewith. The total height of this stove is 2 ft. 3 in., and the maximum consumption 2,800 watts; six regulating switches are provided. The inside measurements are 18×15×12 in. high. There are ten heating tubes, and in the top of the oven are two openings for boiling and stewing.

Model No. 1 is a larger size, 3 ft. 6 in. high, and takes a maximum of 4,000 watts.

Lamp-Holder Suspension Clip.

This clip has been designed by Mr. C. W. Denny for the purpose of attaching to any ordinary lamp-holder, to suspend the lamp from a wall, bracket or shelf, and, in fact, any place where a vertical cord hang is not permissible. The device is suitable for shop-window lighting, bazaars, and other places where lamp-holders have to be suspended in awkward or difficult positions. The use of the clip prevents nails, hooks, or other metallic

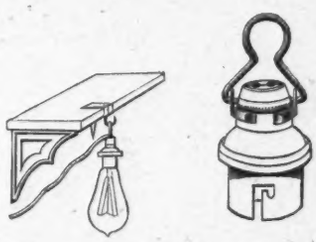

Fig. 3.—"Denny" Lamp-holder Suspension Clip.

appliances coming in contact with the flexible connections, which are apt to become frayed and the insulation weakened when used as a means of support for the lamp-holder. A further advantage is that the weight of the lamp-holder or pendant is removed from the flexible connections. The clip shown in the accompanying illustration is made from spring steel and brass wire, and is being placed upon the market by the Clarence Engineering Co., Ltd., 3, Cherry Tree Court, Aldersgate Street, E.C.

ELECTRICAL FIRMS AND THE COPPER COMBINATION.

The reported formation of a combination to restrict the production of copper in the United States aims at bringing about an increase in prices, and there seems reason for believing that quotations will advance in the near future. If consumers were to exhibit anxiety on this point, the question would specially affect the electrical industry in the manufacture of cables. In discussing this subject a German newspaper points out that from the profit standpoint the electrical firms in that country are independent of the price of copper prevailing at any time, seeing that the contracts contain a clause making provision for fluctuations, and in the case of contracts for bare or insulated cables, it is arranged that the prices are to remain open and be fixed according to the market price. If the companies have to bind themselves to the prices of insulated conductors, as in the case of public competitions, a clause somewhat as follows is provided:—"The prices for insulated conductors are founded upon a basis price for electrolytic copper of £ to £ , and are increased by ·2 mark (2½d.) per 1 square millimetre cross-section and 1 kilometre long for each £ begun, or are reduced by the same amount for each complete £, by which the London quotation for electrolytic copper is higher than £ or lower than £ on the day of the receipt of the order." A similar clause is usually inserted in contracts for the delivery of lead-covered cables.

The result of the insertion of provisions of this character in contracts is that the electrical companies are not directly

interested in the rise or fall in the price of copper. Of course the orders for cables in a period of extraordinarily high prices for copper are less numerous than when normal or low prices prevail, as it may be assumed that about one-half of the value of cables is represented by the cost of copper, and the remainder by other materials, labour, profits, &c. The proportion of copper used in the construction of electrical machinery is insignificant as compared with cables, amounting to from 6 to 10 per cent. of the total consumption of a large firm. It is therefore necessary for the works, apart from cables protected by a clause of the kind above mentioned, to keep stocks of copper for use in the making of machinery and for other purposes, as such a clause is not usual in these cases, but these stocks in general are not so considerable as is sometimes assumed. The firms will naturally cover their requirements on a large scale when they conclude from the situation of the copper market that an advance is probable. The stocks in the case of the large German companies that are not appropriated for orders should not exceed 1,000 tons; stocks of several thousands of tons are regarded as very considerable.

The total copper consumption of the Allgemeine Elektricitäts Gesellschaft, the Siemens-Schuckert Works and the Felten & Guilleaume-Lahmeyer Works is estimated at from 60,000 to 65,000 tons per annum, and is approximately divided among them uniformly. As a consequence of the protection clause in contracts, it follows that neither large profits nor large losses can result to makers in respect of the cable department, in which by far the greatest amount of the copper is used, and the prevailing price of copper therefore cannot have a determining influence upon the remunerativeness of the undertakings, although it still forms a factor which directly or indirectly cannot be left out of consideration. Suggestions have repeatedly been made to the large companies to render themselves free from the purchase of copper in the market by the acquisition of copper mines, or by taking a financial interest in them, but the proposals have not met with sympathetic reception, as the consumption of even the largest undertaking is not large enough to justify such an association with a single mine. The reports of a copper trust have not caused the companies to depart from their usual rates of supply, thus showing the opinion entertained in electrical circles as to the probable development of the market.

The tone in the brass trade in Germany seems to be similar to that prevailing in the electrical industry. Brass contains from 60 to 70 per cent. of copper, and makers have not found any occasion for providing themselves with specially large stocks owing to the reports of a copper trust and its possible consequences. In case the trust or combination should attempt to force up prices very high, the brass trade would look out for various substitutes, such as brass-plated iron, whilst the electrical industry would devote more attention to the use of aluminium wherever possible. Indeed, the producers of aluminium, of which large stocks are believed to be held, and which is now suffering from a productive capacity that is considerably in excess of the demand, would find a favourable opportunity for stepping into any gap that might be caused by inflations in the price of copper.

BUSINESS NOTES.

Brussels Exposition, 1910.—At the forthcoming Exhibition at Brussels the boiler room will be an attraction. It is to form a part of the International Machinery Hall, and there are to be ten large water-tube boilers of Continental make, to provide the steam for power, light and heating purposes, and the latest and most approved boiler accessories of almost every description are to be included. It is interesting to note that English-made stokers have been selected for these boilers, the Underfeed Stoker Co., Ltd., having received the order for the equipment of the boilers with their system of mechanical stoking and mechanical draught. These stokers will be of the self-cleaning mechanical underfeed pattern, and the fans for the forced draught are to be direct connected to electric motors. The Underfeed Stoker Co., Ltd., will have a stand in the British Section of the International Machinery Hall, where they will exhibit stokers for various classes of boilers, as well as their patent air heater, &c.

The Future of Turkey.—Reuter's Constantinople representative, in a dispatch appearing in the *Financial Times*, makes the following interesting observations on the subject of Turkish concessions and the precautions that are being taken by the new Government. He writes as follows:—

"Ever since the new *régime* came into force in Turkey, the Ministry of Public Works has been literally besieged with applications for all kinds of concessions. So numerous have been these demands that the Ministry has been seriously embarrassed by the claims on its attention, and has finally devised a plan with a view to eliminating such as were not serious or did not enjoy proper backing. It was announced that no applications would be entertained which were not supported by a certificate of financial and technical aptitude, and a delay of one month was granted for this guarantee to be furnished. This measure has been entirely successful. Out of nearly 400 applications which had already been submitted to the Minister of Public Works only four were able to establish their soundness and good faith; the rest, for the most part, were speculative demands by concession-hunters who would afterwards attempt to sell their concession to the highest bidder."

Mr. Fairbanks, late Vice-President of the United States, who is at present making a tour round the world, will arrive in Constantinople from Egypt about the middle of next month.

Private Meetings.—Mackey's Electric Lamp Co., Ltd., Tulip Place, New Church Street, Bermondsey, S.E.—In compliance with Sec. 188 of the Companies' (Consolidation) Act, 1908, a meeting of the creditors of the above was held on December 24th, at the Manchester Hotel, Aldersgate Street, E.C. The liquidator (Mr. Walter Bean, of 174, Aldersgate Street, E.C.) submitted a statement of affairs as at December 9th last, and this showed liabilities amounting to £7,294. The claims of trade creditors were only £315 13s., and there were sundry creditors for £1,433. The balance of £5,545 represented an amount due to Mr. J. A. D. Mackey, in respect of rent and money lent to the company. After allowing £100 10s. for preference claims, the assets were expected to produce £639, being made up as follows:—Cash at bank, £10; good book debts, £283; estimated to realise, £276; stock-in-trade valued at £64; machinery expected to produce £371; and fixtures and fittings, £17. In addition to the liabilities shown on the statement, there were debentures to the extent of £2,500, on which no interest had been paid by the company. The debenture-holder was Mr. J. A. D. Mackey. The liquidator reported that the company was formed some nine or ten years ago by Mr. Mackey, the present debenture-holder. The debentures had been issued for cash advanced by the vendor; and no part of the purchase price was paid by the company by the issue of debentures. Mr. Mackey's solicitor stated that if the creditors agreed to the voluntary liquidation of the company, he would make no claim in respect of the debentures he held, and he would also withdraw his claim on the company for £5,500 in respect of money lent. Two of the sundry creditors also informed the meeting that they would reduce their claims on the company by 50 per cent. The liquidator said that under those circumstances there was every prospect of the creditors getting something near 20s. in the £, which Mr. Mackey desired. The creditors passed a resolution confirming the appointment of Mr. Walter Bean as voluntary liquidator. An informal committee was also appointed, consisting of Mr. S. R. Mullard, and the representatives of Messrs. Schmidt & Co., and the Bryant Trading Syndicate Co., Ltd. The following are creditors:—

Bryant Trading Syndicate Co., Ltd.	£66	Mullard, S. R.	£141
Ceramic Co., The	57	Smith, Norman	617
Safety Paper and Box Mnfg. Co.	19	Cash creditors: Mackey, J. A. D.	5,545
Siemens Bros., Ltd.	28	Debenture-holder: Mackey, J. A. D.	2,500
Schmidt & Co.	70	Preferential creditors:—	
Vactite Wire Co.	35	Mullard, R. (salary)	44
Creditors under £10	49	Mullard, S. R. „	19
Bean, Walter	13	Rent	37
Mullard, R.	660		

Dissolutions and Liquidations.—The following letter has been addressed to us regarding a report on the affairs of the Bradford Electrical Engineering Co., Ltd., which appeared under this heading in our last issue:—

"In your issue of the 24th inst. you publish a report of the creditors' meeting of the above company, and as the same contains false, if not libellous, statements, I must ask your permission to place before your readers and those concerned, the true facts of the case.

"The business originally belonged to me, and not to me and my son. The balance-sheet and trading account were drawn up for me by a firm of chartered accountants, who had access to all books and documents kept by me, and were correct to the best of my belief, the results arrived at being similar to those drawn up by me in my own way. Mr. J. H. Haley had the same opportunity, as his account rendered to me shows, 'to perusing the accounts of your firm' are the words used in his account, a document now in the possession of my solicitors. It was on his own proposition that we adopted the trading account already in my possession as the basis of the company formed by him. If Mr. Haley had been a cute man of business, he would have investigated before, and not after, the event. It was in January, 1908, that Mr. Haley discovered, as he said, a deficiency of £341, but how this had arisen was always a mystery to me. At the subsequent shareholders' meeting, I pressed those present to allow me to return the 341 shares which it was alleged I had got more than I ought to have, but was persuaded to retain same as a loan at 5 per cent., to be repaid as I was able. Some time afterwards I was persuaded to sign a promissory note for the £341, something being said as to its being given to the bank if we needed an overdraft. I pointed out to the other directors at the time that it could only be a formal document, as there was no

possibility of my being possessed of this sum, as all that I had was the remuneration from the company, and that not a large amount, but out of which both I and my son repaid to the company as much as we were able. This is the 'amount owing by the vendors under their contract' mentioned in your report. Had I consulted my present solicitors at the outset I should not have been allowed to have taken these steps—signing a document which was subsequently used to oust me from my position.

"Mr. Haley told the creditors that 'ever since the company was formed the trading had not been profitable.' This is false, as the company paid a dividend of 7½ per cent., carrying forward more than enough to have paid a 15 per cent. dividend, besides having paid the flotation expenses out of profits as the result of its first year's trading. Two large bad debts prevented any profits being made in the second year, and for these bad debts, of course, the management was blamed. The question might be asked why Mr. Haley drew a salary of 60 guineas a year for keeping the books and managing the finances, when he says that the company's trading was not profitable.

"It is false to say that the two directors 'resigned their positions on November 18th last.' The facts are that early in October, when it was discovered that we had made a serious loss on a contract through the failure of the principal contractor, we being sub-contractors, the directors asked one of us to resign and seek a fresh post in order to save the expense of a salary. My son, Mr. H. H. Cassé, had the offer of a post, and we reported to the directors this fact, and that he would resign as requested. But the chairman would not agree, saying to me, 'It is you who must go; we are not going to let him (my son) go.' I would not agree, and the meeting was adjourned. At the next meeting my promissory note was produced, and I was told that I must resign or meet the promissory note, which they knew I could not; and under threat of the issue of a writ, I had no alternative but to hand in my resignation, to take place on October 30th, and my son was asked if he was willing to manage the business, to which he agreed. On October 23rd the directors brought in another man to act as manager, and he indignantly refused to work with him, pointing out that he had been appointed to manage, and that I had retired to save the expenses at the directors' wish, and not to make way for another. As the directors insisted on installing 'the new manager,' my son tendered his resignation, which was accepted, and we both left the concern on October 30th last.

"For the bungling and blunders made after this date we own no responsibility—I certainly am of the opinion that the business could have been saved, and ought to have been saved, if all parties had been agreeable, and for the shareholders' and creditors' sakes I am sorry that it has not been saved.

"I must apologise for the length of my communication and for so much of the personal element, but I thought it due to myself, and the creditors especially (by whom I have always been well treated), that I should give something of the other side of the picture.

"C. J. Cassé, Bradford."

Superheaters, Ltd.—This company is winding up voluntarily, with Mr. G. W. F. Dawes, 56, Ludgate Hill, E.C., as liquidator.

Eldon Electric Co., Ltd.—A meeting is to be held at 46, Grainger Street West, Newcastle-on-Tyne, on January 31st, to hear an account of the winding up from the liquidator, Mr. A. G. Robson.

Heele & Co., dealers in scientific and other apparatus, Ealing.—Messrs. P. Heele and G. H. Ironmonger have dissolved partnership.

R. E. Walker, electrical engineer and cycle agent, Eign Road, Hereford.—First meeting of creditors, January 5th; public examination, January 18th—both at Hereford.

Shipley Fan Co., Well Croft Works, Shipley (electrical and ventilating engineers).—Messrs. W. Walsh and J. Whitfield have dissolved partnership. Mr. Walsh will attend to debts and continue the business under the same name. Mr. Whitfield will carry on a similar business, also at Shipley.

"Metalik" Lamps.—In connection with Mr. Lavender's research on metallic-filament lamps, of which an abstract appears elsewhere in this issue, we are informed that the lamps tested in Set No. 3 were Messrs. G. M. Boddy & Co.'s "Metalik" lamps.

Franco-German Co-operation.—It is stated that the Felten & Guilleaume-Lahmeyer Works have concluded an agreement with the French firm of Schneider & Co., of Creusot, for the working under licence of a number of electrical manufactures. As a first result of the arrangement the latter has received from the Southern of France Railway Co. an order for the construction of an electric locomotive for main line service of 1,400 H.P., whilst the former firm will provide the electrical equipment. The locomotive is to be of the single-phase type, and it is assumed that further orders will follow the completion of the engine. In addition, both firms have jointly obtained an order for an electric rolling mill equipment for the Italian Terni Steel Works.

Book Notices.—*The "Practical Engineer" Pocket Book, and the "Practical Engineer" Electrical Pocket Book for* 1910. London: The Technical Publishing Co. Price 1s. each, net.—Concerning the former, such an old friend needs no more than kindly mention, for its merits are too well known to call for emphasis. The amount of information embodied in it is astonishing—and it grows fatter every year.

Its electrical younger brother has not been before the public so long, but is growing in size and popularity, and a variety of new sections has been incorporated with the new edition. One of these (candle, International) is indexed page 358, instead of 338, and the new ratio should be adopted in such tables as that on page 342. We are interested to learn (page 343) that Osram lamps are now made of 16 C.P. at 200-220 volts; perhaps this is an "intelligent anticipation." On page 403 silicon is repeatedly spelt silicum; an error such as this, which can hardly be due to the printer, greatly depreciates the value of the section in which it occurs, by shaking the faith of the reader in the qualifications of the author. However, we have found but a few of these, and the matter generally is kept well up to date. Some of the blocks need renewal—for instance, on pages 102, 125, 173, &c., and historical matter, such as the description of the old Brush and Thomson-Houston lamps, is out of place in a pocket-book. The diary is printed on sectional paper.

Directory of the Royal Society of Arts.—Edited by Sir H. T. Wood. London: George Bell & Sons. Price 2s.—This pamphlet contains a short sketch of the Society's history, an account of the Trust and Prize Funds which it administers, a history of the Examinations which it has carried on for the past 50 years, the Charter and By-Laws, and other general information, including a list of the Proceedings of the past session, and a financial statement for the past year.

"Science Examinations, 1909."—Reports on the science examinations and summaries of the results, &c. London: Wyman and Sons. Price 6d.

"Practical Electrician's Pocket Book and Diary, 1910." London: S. Rentell & Co. Price 1s. net.

Trade Announcements.—Messrs. Watson & Whyte, of 19, Waterloo Street, Glasgow, have taken over the agency for Glasgow and district, for the portable electric circular saws of Messrs. Feld Bros. & Co., Ltd., of London.

The works of the Electric and Ordnance Accessories Co., Ltd, of Aston, will reopen on Monday morning next, after stock-taking.

Mr. Harry Moss, late manager for Mr. Chas. Pullan, of Bradford, will commence in business as an electrical engineer and contractor, on January 1st, 1910, at 116, Horton Grange Road, Bradford. He desires to receive manufacturers' price lists and catalogues.

Messrs. J. & H. Grevener announce that their branch in Manchester having now been thoroughly organised there, Mr. H. J. Booker is returning to London again to take charge of their motor department.

Closed for the Holidays.—Messrs. Hurst, Nelson and Co., Ltd., of Motherwell, announce that their works are closed for the New Year Holidays until the morning of Thursday next, January 6th.

Unfair Overloading.—As showing the heavy strain to which electrical apparatus is often unfairly subjected, the Foster Arc Lamp and Engineering Co., Ltd., inform us that some 15 months ago they supplied a "Foster" auto-transformer, 110/50 v., output 500 watts, which was installed and loaded to 1,250 watts, a load which it had to carry some six hours continuously day after day. After over a year's service it, of course, broke down. If proper precautions were taken to ascertain the correct size and capacity of apparatus before ordering, fewer complaints would be lodged against manufacturers, and one would hear less about the uncertainty of electric light and the fire hazard attaching to it. The fact that the transformer stood the strain so long speaks well for its design and construction.

Carbide of Calcium.—The Usines Electriques de la Lonza, of Yampel, in the Swiss canton of Vallais, which are principally engaged in the production of carbide of calcium and iron alloys, report a very unfavourable period in 1908-9. The accounts show a loss of £18,900, which is mainly attributed to the depreciation of securities in the company's portfolio, this result comparing with a profit of £28,900 and a dividend of 5 per cent. in 1907-8 on a share capital of £480,000. Although the undertaking is passing through a critical time, which may still influence the year 1909-10, the report states that as the company's products have gained a market better results may be expected at a later period.

Calendars and Catalogues.—Messrs. John Spencer, Ltd., Globe Tube and Engineering Works, Wednesbury.—Trade price list of wrought-iron tubes and fittings, also another of their aluminium date-calculating pocket disks.

Messrs. Wm. Geipel & Co. have sent out to their friends, ourselves among the number, one of their vest-pocket diaries for the new year. It differs from diaries so far received this year, for it contains a £1,000 accident coupon. Some pages in the front of the book contain particulars of the firm's specialities and useful engineering tables.

Messrs. W. Leonard & Co., 4, Soho Street, Oxford Street, W.—Priced leaflet of electric reflector signs.

The Electrical Co., Ltd., 122-124, Charing Cross Road, W.C.—Eight-page illustrated and descriptive price list of their arc lamps for indirect lighting.

Messrs. Siemens Bros. & Co., Ltd., Caxton House, London, S.W.—Eight-page pamphlet (Reprint No. 506B), in which are given reprints of two papers on "Roentgen-Therapy in Gynæcology" (with illustrations), by Prof. Dr. Athers Schönberg, from the *Archives of the Roentgen Ray.*

Mr. John Whitelaw, electrical and mechanical engineer, 15a, Duncan Street, Edinburgh.—Wall calendar for 1910, with monthly tear-off slips placed beneath a capital colour print of a child-life picture, "The Greatest Show on Earth," by an Austrian-American artist, Karl Witkowski.

The Mirrlees Watson Co., Ltd., Scotland Street, Glasgow.—Pamphlet C26, in which is contained an illustrated description of

an exhaust steam turbine installation at Messrs. Nobel's Explosive Co.'s Ardeer Works.

Mr. G. Braulik, 8, Lambeth Hill, E.C.—New price lists of "Eclipse" semi-enclosed long-burning arc lamps, and of the "Eclipse" automatic transformer switch.

Messrs. W. F. Dennis & Co., 49, Queen Victoria Street, E.C.—The "Useful Tables and Data," issued last year on a card have been revised and issued in pocket form, in a neat little leather case, provided with pockets for stamps, &c., making a very neat and handy souvenir. The tables relate to wire gauges, iron wire, copper conductors, conversion tables, &c.

Mr. John Gregory, Nelson, Lancs.—Leaflet describing the "Eureka" electric motor-driven surfacing machine for levelling down new or cleaning existing floors.

Messrs. Alfred Herbert, Ltd., Coventry.—We have received this firm's calendar for 1910. The date figuring on each monthly sheet is, as usual, boldly printed, making it useful for the office wall. Each sheet gives an excellent half-tone print of one or other of the firm's machine-tool manufactures. Copies of the calendar can be obtained on application by firms interested.

LIGHTING and POWER NOTES.

Barking.—The electrical engineer has been directed to report upon a letter from the general manager of the British Coalite Co., stating the terms upon which the company would supply the Council with electricity in bulk. The electrical engineer, together with the surveyor, are to report upon a proposal to sink a well for the purpose of supplying water to the generating station; experiments by the Barking Gas Co. in the same direction have been very satisfactory.

Bedford.—The T.C. on Wednesday decided to rescind terms for differential rates for lighting current now in force, and to replace them with terms making it optional for any consumer whose annual consumption of electricity for lighting purposes reaches or exceeds 3,120 units, to pay either at the existing rate of 5½d., or 6½d. per unit from sunset until 8 p.m., and 4½d. per unit during the remainder of the day, the above charges subject to a discount of ½d. per unit, when accounts are settled within a month of delivery.

Belfast.—The scheme for the public lighting by electricity of a large number of the streets is to be gone on with at an early date it is understood. The lighting will be by arc lamps.

The Board of Guardians has commissioned its architects, Messrs. Young & Mackenzie, to prepare the plans and specifications for the electric lighting of the Abbey Sanatorium. The scheme will involve an outlay of £4,405, and an annual upkeep of close on £900.

Bexhill.—On December 21st a L.G.B. inquiry was made into the application of the T.C. for a loan of £3,058 for electricity purposes. The Inspector (Mr. H. R. Hooper) suggested that a further loan of £1,500 should be asked for, as the total amount would then meet prospective expenditure for about 2½ years. There was no opposition.

Bridgend.—It is reported that a gross profit of £1,116 has been made on the electrical undertaking up to November 18th, since the works were taken over by the Council; the net profit is £175.

Broadstairs.—The U.D.C. has consented to the Isle of Thanet Electric Tramways and Lighting Co. submitting a scheme for electrically lighting Dumpton Park Drive. The lamps could be attached to the tramway poles at little cost.

Camberley.—A recent meeting of the ratepayers decided that the U.D.C. ought not to take up an electric lighting order unless sufficient support were assured to make the venture profitable. There is a strong feeling, however, in favour of the scheme, which was prepared by Messrs. Medhurst & Brewer.

Canada.—According to the *Canadian Engineer*, some 40 water wheels near Ottawa are now equipped with heating devices to prevent "frazil" from clogging and stopping the wheels and gate mechanism. The Ottawa and Hull Co., which supplies the Ottawa distribution system, has added a 100-H.P. boiler to its "frazil combatting" plant, and expects to keep up its output of 10,000 H.P. without trouble. The latest 3,000-H.P. unit is provided with cored chutes and gate chambers with pipe connections, so that steam or hot water may be circulated. The power houses of the Ottawa Electric Railway and Ottawa Electric Co. are also equipped with water wheel heating systems. At all these plants the works have, so far, been kept free of ice by electric motor-driven rakes, and no heat has been utilised.

The B.C. Electric Railway has just installed a new 10,500-H.P. wheel and generator at Lake Buntzen, bringing the number of power units up to five, operating on four transmission lines. The new unit consists of a Doble wheel supplied through a 7-ft. diameter pipe, and coupled to a Dick-Kerr generator.

Castleford.—The U.D.C. has decided that, in view of the possibility of its dealing with the application of electricity for public lighting under the order of the Yorkshire Electric Power Co., the present time is inopportune for extensive alterations in gas lighting.

Continental Notes.—France.—The T.C. of Bourg, in the department of the Ain, has received proposals from the Lyons Gas Co. for the lighting of the town by electricity, but before coming to a decision, has decided to await the proposals which may come from any other societies.

The T.C. of Mâçon has passed a resolution advocating the undertaking of works on the upper Rhone in order to make it navigable and to facilitate the construction of a hydro-electric station at Genissiat.

For once in a way, the efforts of M. Pataud, the electrical agitator, to inconvenience Parisian electrical users have failed. It appears that Pataud had engineered a scheme to deprive the city of electric light on Friday or Saturday last, and lodged a sort of ultimatum with the Minister of the Interior at the last moment. Owing, however, to the authorities having got wind of the affair, and to the linking up of the various generating stations, suitable arrangements could be made to frustrate any complete strike.

Russia.—The municipal authorities of Jersk, Caucasia, are considering the question of establishing a central electric lighting station in the town.

Holland.—Work is about to be commenced on the establishment of a central electric lighting station in the town of Gouda.

Germany.—An electric scheme to serve Fürstenberg and 15 other townships in the Bernese Oberland has been launched, a company being formed for this purpose. It is proposed to build an electric station and supply energy at 10,000 volts, which will be transformed down to 110 and 120 volts, the price charged to the consumer being 20 pfennige for power and 30 pfennige for light. The construction contract has been secured by the Frankfurt Lahmeyerwerke.

Sweden.—According to the *Affärsvärlden*, the first Swedish factory for the manufacture of calcium cyanamide is expected to be in working order in the winter of 1911. The Stockholm Superphosphate Co., Ltd., has bought three waterfalls in Ljungan, Norrland, near Sundsvall, for the purpose, and the plant will have a capacity of 15,000 H.P.

Dublin.—The South Dublin Union Guardians have decided to ask the L.G.B. to hold an inquiry into the relative merits of gas and electric lighting for the workhouse, &c., and to advertise for tenders for both gas and electric lighting at the conclusion of the inquiry. Gas lighting now costs the Guardians £1,500 per annum, and a recent quotation is £1,142. The Corporation has offered to fit up and light the building by electricity for £1,295, £750 being for the lighting itself and an alternative quotation was £293. An outside company has offered to supply electricity for £750 per annum on a 10 years' contract.

Gillingham (Kent).—As the result of the investigation into the working of the electricity undertaking, the T.C. has decided to forthwith install a Diesel engine at a cost of £3,112. A loan is to be applied for, and, if refused, the money will be raised from current revenue.

Haslingden.—In order to retain its powers under the E.L. order, which has several times been extended, Haslingden T.C. has by the end of February next to show the B. of T. that it is definitely prepared to exercise the powers. Hitherto it has hesitated because of fears that the scheme might not prove commercially successful. It has, however, just ascertained that 75 per cent. of the tradesmen in the borough are willing to adopt electricity for lighting, and there are also fair prospects of a good demand for power purposes.

Hull.—The T.C. is negotiating for the supply of electricity to the new pier of the Hull and Barnsley Railway Co.

Kingston-on-Thames.—The work of converting gas lamps to electric glow lamps in six roads is to be put in hand.

Littleboro'.—At a recent meeting of the District Council an agreement between the Council and Messrs. Hawtayne & Zeden, having reference to their terms for acting as consulting engineers in carrying out the work in connection with the supply of electricity from the Rochdale Corporation, was approved and the seal of the Council attached. The clerk was instructed to make application to the L.G.B. for the borrowing of £3,500, to be repaid in 25 years, to carry out and complete the laying of cables, transformer station, &c. The clerk was also instructed to obtain terms for land for the erection of a transformer station near Hare Hill Road corner.

Lancaster.—The new municipal buildings which Lord Ashton has given to Lancaster at a cost of £155,000, are lighted by electricity. The installation is fed from two points with special feeder mains from the electricity station of the Corporation, which is in close proximity to the buildings. At each point the current is brought in on the three-wire system, and divided into eight circuits, four on each side. The circuits are carried in solid drawn steel conduits with junction boxes, and are controlled by a triple-pole ironclad switch. The fittings in the main apartments, which are very large, are all suspended with a special clutch gear, which is actuated by a steel wire-rope winch, this enabling the fittings to be lowered for cleaning and relamping. As far as practicable, the whole of the lighting is by metallic-filament lamps, numbering upwards of 1,000; there are 150 lamps in the public hall with a total of 7,500 C.P. The electroliers are of wrought-iron and hand gilded. The whole of the fittings, with the exception of those in the public

hall, which seats 2,500 people, are made in coinage bronze. The portico at the main entrance is lighted by means of five large lanterns, each containing four 56-c.p. lamps. Mr. F. Dare Clapham, F.R.I.B.A., designed the fittings, which were made by Messrs. Veritys, of Manchester. The contractors were Messrs. Calvert & Heald, of Market Street, Lancaster, whose representative, Mr. A. Davies, has personally superintended the work.

London.—Hampstead.—The B.C. has introduced the "telephone rate" system of charging where both heating or power and lighting are required—the charge to be £8 5s. per kw. of maximum demand for lighting, and 1d. per unit for all energy supplied for all purposes. The system is only applicable to private houses, &c., where the whole of the premises are lighted by electricity.

Maidstone.—The T.C. has sent a circular letter to the various local authorities throughout the country owning electricity undertakings, asking them to contribute towards the promotion of a Bill in Parliament to enable local authorities to undertake the wiring of consumers' premises and the sale of fittings.

Oldham.—The T.C. has received from the Royton U.D.C. permission to supply electricity in the district upon the same terms as exist at Oldham.

Perth.—The Corporation Gas Works Committee is considering a proposal to introduce an electrical stoking plant at the gas works.

Rochdale.—This week the Electricity Committee had before it a report of Mr. C. C. Atchison, electrical engineer, on the proposed extensions at the electricity works to meet the great development of the business, and the largely increased demand for supply, which will have to be met when the cars run to Whitworth, Bacup and Milnrow. There is also the supply in bulk to Littleboro' to be provided for. A battery is to be provided at a cost of £7,500, which, however, is only part of a larger scheme which it is expected will ultimately involve an expenditure of £40,000, or thereabouts. The Committee proposes to ask for borrowing powers for £4,000 (in addition to the £7,500) for cables, and £600 to cover the cost of treating water taken from the river. The loan now to be applied for thus totals over £12,000.

Southend-on-Sea.—The T.C. has decided, as a tentative measure, to charge 1½d. per unit for energy for radiators until the end of May next.

A loan of £3,000 for meters has been applied for.

For all-night public lamps the following charges have been fixed:—One 50-c.p. Osram lamp, £4 per annum; two 32-c.p. Osram lamps, £5 per annum.

Swinford (Ireland).—The R.D.C. of this place has decided to proceed with the electric lighting scheme which was projected some months ago.

Walthamstow.—The electrical engineer has been authorised to lay cables to supply current to a factory in Macdonald Road, and the street lamps along the route of this extension are to be converted from gas to electricity. After January 1st the charge for power to consumers of 30,000 units and over per annum is to be reduced to 1d. per unit.

TRAMWAY and RAILWAY NOTES.

Aston.—Travellers on the Perry Barr tramway route from Birmingham, or *vice versa*, have long grumbled at the necessity of having to change cars at the Six Ways, Aston, and have wished for a through service of cars to Perry Barr. This has now come into operation. At the time the new service started, however, one matter had not been adjusted. The fares in force were from Newtown Row to Perry Barr 1½d., and the through fare was 2½d. The Aston authorities were prepared, provided Birmingham would consent, to make the Six Ways at Aston the penny stage from town, instead of the city boundary, Newtown Row, as at present. This would make the through fare 2d., which the public who use the line—and it passes through a populous district—would naturally prefer. It remains to be seen whether the public will appreciate the change. It appears to be slight, for all that the new arrangement does is to ensure that the Birmingham cars continue their journey to Perry Barr.

Continental Notes.—France.—A trial run was recently made over the first electric railway constructed on the great railway system of the Midi. The line runs from Villefranche-Verneh-les-Bains to Mont Louis, and is said by *La Revue Pratique de l'Electricité* to be of an exceptionally bold design, being built on the side of a very steep range of mountains. It has a length of 28 km., and rises from a height of 427 metres to 1,510 metres by means of gradients, varying from 25 to 60 mm. per metre. A feature is the Gisclar Bridge, hung by metallic cables 80 metres above the bed of the Tet, and certainly noteworthy among the most daring constructions of the kind in Europe. The line was opened to traffic on the 25th ult.

Germany.—During the last few years the question has often been raised as to the desirability of the purchase by the Berlin Municipality of the undertaking of the Berlin Tramways Co., but without definite result. At the present time the municipality and the company have suspended large construction schemes which had been decided upon. The company has had in contemplation the building of an underground railway system, but shows no sign of carrying the proposal into effect. It is said that both parties are ready to adopt the principle of repurchase, provided a scheme satisfactory to both can be discovered. The most important point, of course, is the purchase price, concerning which there are varied estimates. In some quarters it is asserted that the price will probably work out in the neighbourhood of 200,000,000 marks.

Italy.—Work has recently been completed on the construction of an electric tramway, about 5½ km. long, between Birano and S. Lucia Portorosi, Istria.

Exeter.—The Tramway Committee has received a letter from the Chamber of Commerce asking consideration of the question of issuing books of tramway tickets as adopted at Bournemouth and other towns. The Chamber has been informed that the Committee sees no reason for altering its previous decision not to adopt this system in Exeter.

Kirkcaldy.—In the Provisional Order promoted by the Corporation, power is asked to construct and work additional tramways in and adjacent to the burgh, to confirm an agreement with the burgh of Dysart as to the working of tramways, to extend the area of supply of electricity, and to confer further powers on the Corporation in relation to its electricity undertaking.

Nottingham.—Though it entailed a loss of £500, the City Council gave all the tramway employés a holiday on Christmas Day, and not a single car was run. This caused a good deal of inconvenience to those attending the Notts and Chelsea football match at Trent Bridge.

Perth.—Mr. Peter Fisher, tramway manager, Dundee, has visited Perth with the object of preparing a report on the working of the Corporation tramways and making suggestions as to how the system can be improved.

Rhondda.—The U.D.C. has decided to seek powers to construct additional tramways, which are to be leased to the Rhondda Tramways Co., Ltd.

West Fife.—The portions of the Dunfermline and District Tramways between the West End and Cowdenbeath and the terminus at Lochgelly have been inspected by Colonel Von Donop, and the service has been commenced.

York.—The tramway track is now completed from the terminus at Fulford to Railway Street, and from the city boundary to Dringhouses, about a quarter of a mile still requiring a small section of the permanent way to be laid and the widening of Queen Street Bridge. The committee recommends that the section between Fulford and Nessgate be opened for traffic as soon as the necessary arrangements can be made for the purpose, subject to the lines being passed by the B. of T. The amount authorised to be borrowed in respect of the Light Railways Order is £130,170. The amount of the contracts already entered into for the purchase of properties, construction of tramways, strengthening of Lendal Bridge, &c., and the purchase of the old tramway undertaking is £115,412, of which £42,397 had been expended up to December 21st.

TELEGRAPH and TELEPHONE NOTES.

Cable Co.'s Jubilee.—The Commercial Cable Co. has just attained its 25th anniversary, having been founded in December, 1884, and in celebration of this event Mr. Clarence H. Mackay, president of the company, entertained the staff at dinner at the Great Eastern Hotel, London, on Monday last. The officers and employés were also invited to dine at various provincial centres, the centre for the North of England being the Angel Hotel, Liverpool, where representatives were present from Liverpool, Manchester, Bradford and Newcastle-on-Tyne, under the chairmanship of Mr. Joseph Fauze, Liverpool superintendent of the company. The Scottish staff dined at the St. Enoch Station Hotel, Glasgow, Mr. H. J. Tracey, the Glasgow manager, presiding.

Cables Interrupted.—Obok-Djibouti, December 20th; Tourane-Amoy, December 27th.

Wireless Telegraphy.—On the resumption of the case in which R. S. Knowlden was charged with stealing a wireless receiver from H.M.S. *Vernon* torpedo school, serious additional charges were preferred, it being stated that at his house were found other instruments and over 80 drawings of wireless telegraph apparatus, embodying the whole of the secret improvements effected in wireless telegraphy for the British Navy, and including information of a very confidential character. Commander Maurice, of the *Vernon*, gave evidence to the effect that the prisoner had been warned that no copies should be made without authority, and that the plans and apparatus were found at his house. Other evidence was given, and the prisoner was committed for trial, bail being allowed.

CONTRACTS OPEN and CLOSED.

OPEN.

Austria.—January 15th. An electric generating station is about to be established in connection with the State Tobacco factory in Vienna, and tenders are being invited by the authorities for the supply of a dynamo, 16 electric motors, and four electric lifts, in connection with the same.

Australia.—Melbourne.—February 2nd. Electrically-driven pump for the City Council. See "Official Notices" December 10th.

Sydney.—January 11th. A power station generating equipment for the Lithgow Small Arms Factory, New South Wales, for the Commonwealth. See "Official Notices" December 10th.

Sydney.—Two junction-line sections of common-battery switchboard for the P.M.G. See "Official Notices" December 24th.

South Australia.—Telegraph and telephone material for the P.M.G. See "Official Notices" December 24th.

Belgium.—February 26th. The municipal authorities of Bree (Province of Limburg) are inviting tenders for the establishment of a central electric lighting station in the town.

Belfast.—January 10th. One 1,500-kw. continuous current turbo-generator and condensing plant for the Corporation. See "Official Notices" December 10th.

Bridlington.—January 1st. 300-kw. steam dynamo for the Corporation. See "Official Notices" December 10th.

Brighton.—January 10th. One 3,000-kw. three-phase turbo-alternator, with condensing plant, &c.; one 1,300-h.p. 8,000-volt three-phase induction motor; one 300-kw. induction motor-driven balancing set; high-tension switchgear, &c., for the Council's North Road sub-station. See "Official Notices" December 24th.

Birmingham.—February 1st. Stores for the Tramways Department. See "Official Notices" to-day.

Dublin.—January 14th. Electric lighting scheme for the new Crookeling Sanatorium of the Dublin Joint Hospital Board. Patrick Nally, Clerk to the Board, Municipal Buildings, Cork Hill, Dublin.

Eccles.—January 15th. 150-kw. steam engine and d.c. dynamo for the Corporation electricity undertaking. See "Official Notices" December 24th.

Erith.—January 10th. High-tension three-phase alternating-current switchboard for the U.D.C. See "Official Notices" December 24th.

Italy.—January 11th. The Ministry of Marine invites tenders for the supply of electric lamps and lampholders. The upset price is put at 150,000 lire (£6,000), and 10 per cent. of this sum will be required as a deposit to qualify any tender. Tenders to the "Ministerio della Marina," Rome.

London.—I.E.E.—January 10th. The Council of the Institution of Electrical Engineers is inviting tenders for the interior wiring and fittings for lighting and power at its new premises. See "Official Notices" December 24th.

Woolwich.—The Electricity Committee is about to invite tenders for a year's cable supplies, based on the variations in the copper and lead market.

CLOSED.

Cleckheaton.—The U.D.C. has accepted the tender of Messrs. Siemens Bros. & Co., Ltd., for cable.

Kingston-on-Thames.—The Council has placed an order with Messrs. Haydn Harrison & Co. for 30 Croydon type fittings for street lighting, at £1 10s. each.

London.—Southwark.—The B.C. has placed an order with Messrs. Sanders, Rehders & Co., Ltd., to supply a "Sarco" combustion recorder for use at the electric light station, at £34 10s. The tender of Messrs. Alfred Blackmore & Co., for the supply of 6,000 tons of Griff or Kingsbury peas, at 11s. 4d. per ton delivered at the Electricity Works, Penrose Street, was accepted.

Messrs. A. W. Penrose & Co., Ltd., have received the contract from Messrs. Wallis-Jones & Dent for the lighting installation at the Holborn Hall and Book Room, which was till recently the Holborn Town Hall.

Maidstone.—The Electricity Committee has accepted the tender of Messrs. Cory & Son, Ltd., for Scotch screened washed peas coal up to August 31st, 1910, at 10s. 11d. per ton.

Southend-on-Sea.—The T.C. has accepted the following tenders:—

The British Thomson-Houston Co., Ltd., London.—Eight traction motors, with gear and gear cases, £582.

Messrs. Sidney Stone & Co., Ltd., London.—Steel tires for tramcar wheels, £1 8s. each.

Wallasey.—The U.D.C. has given an order for 10 electric tramcars, of the patent Brush long-base truck type, to the Brush Electrical Engineering Co., Ltd.

Swansea.—The T.C. has accepted the tender of Glasbrook Bros. for the annual supply of Garngoch coal to the electricity works, at 9s. per ton.

FORTHCOMING EVENTS.

Royal Institution.—Lectures on "Modern Electricity," by Mr. W. Duddell. Saturday, January 1st, "Röntgen Rays"; Tuesday, January 4th, "Generation of Electricity"; Thursday, January 6th, "Electric Oscillations"; Saturday, January 8th, "Electric Lighting." Lectures at 3 p.m.

Institution of Electrical Engineers (Birmingham Section).—Wednesday, January 5th. Meeting at 7.30 p.m. At the University, Birmingham.

Rontgen Society.—Thursday, January 6th. At 8.15 p.m. At 20, Hanover Square, W. Paper by Dr. W. S. Lazarus-Barlow.

Institution of Mechanical Engineers.—Friday, January 7th. At 8 p.m. Papers on "The Application of the Pitot Tube to the Testing of Impulse Water Wheels," by Mr. W. R. Eckart; and "An Account of a Visit to the Power Plant of the Ontario Power Co. at Niagara Falls," by Mr. C. W. Jordan.

Electro-Harmonic Society.—Friday, January 7th. At 8 p.m. At Holborn Restaurant. Smoking Concert.

Association of Engineers-in-Charge.—Saturday, January 8th. Social. Dance.

NOTES.

"A Little Nonsense."—One of our contemporaries either credits the trade and its readers with remarkable ignorance regarding the position of electrical affairs in this country, or it has on its staff one of the most inexperienced greenhorns that ever set foot in Fleet Street. Anybody not entirely new to our industry knows that, compared with what was happening a few years ago, the number of new electrical undertakings on the Parliamentary papers for consideration next Session is very small indeed. We gave a list of them in our issue of December 10th, page 927, and a reference thereto will have shown that they consist chiefly of unimportant alterations in powers already granted, extensions of supply areas, extension of time, transfers of provisional orders, financial re-organisations, while only here and there new schemes—trackless trolley proposals, an electric railway and a few lighting provisional orders—are named. Really, the writer in our exchange must have been overwhelmed with his first glance through the legal phraseology of the *London Gazette*, for he sees big contracts indicated in every line. Mark what he says:—

"Parliamentary notices have already been given of a larger number of Important Electrical Undertakings than have ever before been simultaneously projected, and the general outlook is universally declared to be indicative of exceptional activity in all branches of work.

"Competent authorities calculate that even if only a comparatively small proportion of the enterprises already planned are carried into fruition, a sum of upwards of £50,000,000 sterling would be expended during the year in the electrical trade alone."

For sheer unadulterated nonsense we think this beats anything we have seen in an electrical paper for a long time. That the electrical position is improving we believe, as we have already said, but to represent the state of things as given above is no better than the method of some others who are always shedding tears and cannot even at Christmas time throw off their miserable attack of melancholia. Either attitude can only do more harm than good. The merest tyro in electrical matters should know that the Parliamentary applications nowadays are no indication to the probable business of a coming year. If they were, then next year would be quite different from what our greenhorn deduces. When the electrical industry of this country was existing chiefly on public electric lighting and tramway and tube railway enterprises, the applications to Parliament meant far more than they do now, when all sorts of big work is proceeding for which Parliamentary permission is no more necessary than is the consent of the man in the moon—colliery and ironworks electrification, textile mill and other industrial works conversion to electrical operation, installation work and manufactures of all kinds for export, not forgetting plant and mains additions to authorised and existing electric light and power undertakings at home, of which there are more examples advertised for tender lately. The centre of interest for electrical industry is no longer found in the House of Commons Committee rooms, and if we mistake not, it is unlikely to become so again until some other and more or less important change or advance takes place in a new electrical direction. Even when Parliamentary electrical schemes filled *London Gazettes* to bursting their wrappers years ago, one, of course, had no assurance as to the effect thereof on the incoming year. How many of them fell through, unable to survive the preliminary stages, how many dozens of them were

choked by investigation, how many more were financially sickly, or were of a wild-cat character! Even those which did go through in the first six months of the year after filing, could bring but small benefit to the industry in that particular year. And if this was so then, how much more unreliable is it as a guide to-day, when the number of public schemes is very small, and their value a quite indefinite thing. To talk of 1910 being a record year on such evidence as appeared in the *Gazette* really is nothing short of sheer clap-trap, and it would be amusing were it not so utterly ridiculous, that any man pretending to write even an advertisement about the electrical industry, could produce such a statement. But perhaps he was indulging in a little bit of Christmas fooling at the expense of the electrical trade?

Turkish Concessions: A Warning. — When discussing the probable openings for business in Turkey, in our "Notes on Trade Abroad," we dwelt upon the necessity for treading warily in this field. We now observe in the *Times* that the Board of Trade has issued a warning which is of interest to those who may propose to visit Constantinople with a view to transacting business with, or obtaining concessions from, the Turkish Government. "An intimation has been received through the Foreign Office from that Government conveying a warning against unscrupulous persons who, under pretext of acting as intermediaries between them and the Government Departments, merely seek to take advantage of their ignorance of the country and its conditions. As these persons enjoy no credit with the Turkish Government, their services are valueless. The Turkish Government accordingly advise all foreigners wishing to transact business with them to communicate direct with the competent departments, which are always ready to supply any information required and to accord all necessary facilities."

Institution and Lecture Notes.—Electrical Contractors' Association (London).—On Thursday, December 9th, Mr. S. H. Webb read a paper before the Association, on "Registration and Authorisation," in which he pointed out the difficulty of obtaining thoroughly satisfactory all-round workmen, and advocated a return to the apprenticeship system; he laid stress on the importance of retaining control over the apprentice until he attained the age of 21, in order to secure to him the advantage of subjection to discipline. His own firm required apprentices to attend evening classes during their period of service, and claimed that the result was an efficient workman; such men should be registered by the Association. Good workmen had to be made, and employers must be prepared to make some sacrifice to secure the best results. Casual employment had disastrous effects on the character of a youth. Mr. Webb also urged the need of "authorisation" of employers by a recognised authority, with the sanction of the Board of Trade, with a view to maintaining a certain amount of control over them, and preventing untrained persons from entering the trade. Such a system would also secure to the electrical contractor freedom from illegitimate competition, and would ensure his obtaining the trade discount on materials, as in the case of the "Authorised Plumbers."

Leeds University Engineering Society. — Mr. M. Sykes recently read a paper on "Economic Setting of Steam Boilers," in which he remarked upon the small amount of attention paid to the matter by those who were willing to pay the highest price for boilers and accessories, but trusted the setting of them to any bricklayer. The correct setting of boilers contributed largely towards their economy and efficiency, and also to their longevity, and was, therefore, a matter of importance. He gave detailed particulars of the proper method of boiler setting.

University College, London.—An advanced course of lectures on "The Theory of the Propagation of Electric Currents in Telephone Cables and in Electric Conductors" will be delivered by Prof. J. A. Fleming, F.R.S., on Wednesday afternoons at 5 p.m., beginning January 19th, 1910.

Birmingham and District Electric Club.—At the annual meeting of this club the report of the committee stated that the membership was standing at a steady figure, although, owing to the fluctuations in the electrical trade, they were constantly losing useful members who migrated to other centres of industry. A good year's work had been done, and visits had been paid to the steel works of Messrs. Alfred Hickman, Ltd., Bilston, and the Daimler Motor Co., Ltd., Motor Works, Coventry. The club was in a flourishing financial condition. Mr. G. V. Donovan, M.I.E.E., was elected president, and Mr. W. G. L. Riddle and Mr. E. A. Morgan were re-elected hon. sec. and treasurer respectively.

Mr. C. J. Stonier, Corporation Electricity Department, lectured to a large audience in Dundee on "Electricity and its Uses in the Home." The lecture is the first of a series to be delivered by officials of the department.

The Constantinople Telephone Concession.—Since our "Correspondence" columns were closed the following important letter has reached us from Mr. Herbert Laws Webb:—

"The note in your issue of December 17th, page 982, translated from a German newspaper, gives a very garbled account of the method by which the decision with respect to the Constantinople telephone concession was arrived at.

"The system followed by the Committee appointed by the Minister of Finance to examine the various tenders was correct and fair in every respect. The Committee's method was to value each proposal in the light of each article of the original conditions (of which there were 47), and in this way a valuation of each tender was obtained which represented the combined effect of the various factors concerned. Had the Committee made the competition turn upon one or two only of the 47 conditions, then a purely speculative proposal, with nothing serious behind it, might have been accepted.

"The critics of the Turkish Government on this matter seem to take the ground that the idea of providing Constantinople with a telephone service was got up with the object of making a business for some group of bankers and manufacturers, whereas the Turkish Government not unnaturally wish to ensure the best telephone equipment possible and the best telephone service possible for the capital. Consequently, the proposal which offered the greatest guarantees of efficient equipment and efficient service naturally appealed most forcibly to the Government and was bound to be rated first in any fair and equitable system of valuation.

"The facts are all incorrectly stated by the correspondent of the German newspaper from which your note is quoted. The proposal of the East European Telegraph Co. (a small company operating a 200-mile cable between Constantinople and Constanza, and having no telephone experience at all) was not rated superior to mine in any respect, and in its rating by the Committee it received more than double the number of bad marks allotted to the tender of the Anglo-Franco-American group.

"After the classification of the various tenders by the technical Committee—a work which occupied five weeks and was most carefully and systematically done—the only changes proposed by the Committee were modifications of my proposal, not, as suggested by the German correspondent, of the original conditions. These modifications have been discussed in the course of the preparation of the final agreement, which contains various new articles favourable to the Turkish Government.

"It is unfortunate that the unsuccessful bidders for the concession should have inspired the reports sent to the German Press from Constantinople, for the result is to mislead honest public opinion in Germany. But disappointment over a business failure, however keen, hardly justifies bringing charges of irregular methods against a Government department.

"According to my experience, the methods of the Turkish Ministry of Finance are above reproach, and the result of the telephone competition has been the choice of the tender which was the best from every point of view—technical, financial, and administrative.

"Herbert Laws Webb."

The Extinction of a Spark.—

The strings of my mystical lyre
Are riven with sorrow and mute:
So I've thrown the old thing in the fire,
And my "Swan" must be mourner depute.

'Twill tell you the terrible tale
Of Septimus W. Bragg;
A man, who, apparently hale,
Was, alas, an incurable wag.

As the reader has probably guessed,
This gentleman lived in the States;
Where practical joking's the test
Of a citizen's humorous "traits."

One evening he'd supped and he'd sipped
Not wisely and rather too well,
And sine-waving homewards he tripped
On the beams of an arc lamp and fell.

An arm round the standard, he sat
Determined no further to roam,
Till the pavement developed a "flat"
Whereon he could short-circuit "ohm."

A cigar was soon stuck in his "phase,"
But lights for it "lagging," he "surged"
In vain; till his rotary gaze
Synchronised with the arc lamp and urged

Him to foolishly lower the gear
And light his cigar at the arc.
Which he did! . . . The verdict was clear:
"A series lamp earthed by a Spark!"—H. R. T.

Foreign Markets and their Problems.—We have received the following communication from a writer interested in the commercial side of the industry. Those who have followed the various points that we have endeavoured to bring out in "Notes on Trade Abroad," will observe that the writer confirms a good deal that we have already said:—

"Of late there has been much discussion, in view of increased foreign competition, as to whether the methods of the British manufacturer are as up to date as they might be. To electrical manufacturers this especially applies, since the natural trend of affairs is such that the foreign and colonial work should be of even more value to them than the home business itself. Nor is there any reason, we submit, why this should not be so, if the proper ways

and means of securing it are adopted. We are quite aware that there are many firms which cannot be reproached with laxity in this line, yet it may be well again to mention one or two of the said ways and means for the benefit for those which are not yet in line with the times.

"Both the lay Press and the technical papers constantly bear testimony that we fail largely because of the other man being on the spot. It was stated the other day that foreign merchants abroad, in our Colonies, would often order British goods because of their superiority, and so the agents of our rivals who work those markets were obliged to quote for British goods. We are sure, however, that it would be more easy to obtain such orders if the travellers were British. Co-operation might, if properly arranged, provide a solution to the first question—that of cost. Several firms in different lines of the electrical industry might put their heads together and secure a suitable man for a certain ground, as yet outside the scope of their respective businesses. Some preliminary training in the language might be necessary, but that should not be insurmountable, and it is only reasonable to suppose that he would soon repay them for the outlay, and that new business would accrue.

"Another difficulty which often exists is the custom of demanding long credit, and this is in itself no small obstacle to international business relations. If it is considered, however, that many firms in the home business regularly take three or four months to pay their monthly accounts, and, further, that in the case of distant markets like Australia, from 4½ to 6 months' credit is inevitable, the chances are that it will be found better to allow the required term rather than forego the business altogether. A compromise might also be effected by stipulating part payment on dispatch against documents, the balance to follow at a stated date some months later. Where deposits are required with tenders, these are sometimes retained for some time, and tenders should provide for interest on such deposit, which often amounts to a consideration. In some cases the deposit is not returned in full, owing to heavy charges for exchange fees.

"The home correspondence department is another item which should not be omitted. In the cotton trade foreign correspondents are largely used, with the result that business is much facilitated. The general practice on the Continent, outside Germany, seems to indicate that French is most used in business circles for foreign correspondence. German predominates in Scandinavia, in the same way as Spanish does in South America. A home firm receives a letter from Russia, written in French. The reply is written in English, and the chances are ten to one that if the negotiations break down this is due to the fact that the other man does not understand English. It is just as easy to send him a letter in his language, and further to convert for him our standards of coinage, weight and measurements, as to send the whole thing in English, and the result is eminently more satisfactory to both parties. If it is possible for the cotton people to find foreign correspondents, who need not necessarily be other than Britishers, then electrical manufacturers can do it, but we do not recommend the methods now used by some firms in the cotton industry, who employ what are called 'volunteers' as correspondents. Such men will work for six or 12 months for nothing merely to get experience in the business prior to setting up for themselves."

Tramway Club Meeting.—Sunderland district tramwaymen held a meeting in their club room on Sunday, December 19th (Chief Inspector Craggs presiding), at which recreation club matters were first dealt with. The hon. secretary (Mr. J. Richardson) in his annual report showed receipts amounting to £83 16s. and expenditure of £80 12s., leaving a balance of £3 4s. at bank. Mr. Richardson was again appointed secretary.

A meeting of the sick club members then took place, at which Hon. Secretary C. Watson presented his report for the past year, showing an income of £63 17s. and sick relief pay £29 17s., leaving a balance of £34. It was decided to carry forward £6 15s., and to declare a dividend of 13s. per member. The president stated that all the men in the traffic department were now members of the sick club, and more men from other departments were joining. A Committee was then elected. Mr. Craggs was elected president and Mr. Watson secretary.

Conciliation.—According to an announcement made by the Metropolitan Railway Co. to the daily Press, as a result of meetings of the Sectional Conciliation Boards, formed a short time ago under the scheme agreed to with the Board of Trade, satisfactory settlements have been arrived at with the whole of the company's employés in the traffic department and also in the permanent way department. The altered conditions of service, &c., come into effect this month, and the settlement covers the period up to the end of 1913.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The marriage took place on December 23rd of MR. J. R. PARKINSON, engineer to the Newcastle-Emlyn and District Electric Supply Co., Ltd., to Miss S. A. Jenkins, of Waunmarlog, Newcastle-Emlyn.

Tramway Officials.—MR. J. GRAHAM, of Brisbane, has been appointed, from among 21 applicants, general manager of the Rockhampton Corporation Tramways, Queensland. He went out from Leicester in October, 1908, since when he had been in the service of the Brisbane Electric Light Co., and the Brisbane Tramway Co., and of the Toowoomba Electrical Co., drawing up for the last-named a report for a Toowoomba tramway system. Prior to going out to Australia Mr. Graham had had 12 years' experience in connection with the Sheffield and Leicester Corporation tramways.

MR. FRANK HINCHCLIFFE, an inspector of the Salford Corporation tramways, was, on the 24th inst., presented with a gold watch and a sum of money for the services he rendered to the Prestwich police in the arrest of two men. The presentation was made by Supt. Keys on behalf of the members of the Manchester Division of the Lancs. County Constabulary. Mr. Hinchcliffe had a severe struggle with the prisoner on a car, and but for him, said Supt. Keys, no arrest would have been made.

General.—From the 25th inst. the title of the firm of Lacey, Sillar & Leigh will be LACEY & SILLAR, the junior partner of the firm, Mr. F. A. C. Leigh, having accepted the appointment of chief electrical engineer to the London and North-Western Railway Co.

Obituary.—DR. SHELFORD BIDWELL, F.R.S.—The death occurred on December 18th of Dr. Shelford Bidwell, in his 62nd year. Some 35 years ago he was called to the Bar, but his bent was scientific research, and he became an F.R.S. in 1886, an M.I.E.E., and was twice president of the Physical Society. In reviewing his career the *Times* writes as follows:—"One of the first questions that engaged his attention was that of the change caused in the electrical resistance of selenium by light. This phenomenon had been noticed by Willoughby Smith in 1873 and had been studied by various other investigators, but Bidwell was the first, in 1881, to utilise this curious property of the substance for a purpose to which others have subsequently applied it with more or less success—the electrical transmission of pictures to a distance. A few years later he was working at various questions connected with magnetic action, such as the changes produced by magnetisation on the dimensions of rods and rings of iron and other metals, and later still at problems of physiological optics."

MR. A. A. WHITLOCK.—We regret to learn of the death, on the 26th inst., at 4, Rossdale Road, Putney, of MR. A. A. Whitlock, who was for 11 years resident engineer at the County of London Electric Supply Co.'s Wandsworth station, and previously resident engineer of the Dover electric supply undertaking.

MR. W. H. WHITWORTH.—The death has occurred of Mr. Wm. Henry Whitworth, manager of the Liverpool branch of the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., of Silvertown.

NEW COMPANIES REGISTERED.

Aluminium Corporation, Ltd. (106,421).—This company was registered on December 14th, with a capital of £450,000 in 5,000 participating shares of 1s. each and 149,750 preferred and 300,000 ordinary shares of £1 each, to acquire certain freehold lands, water rights and properties referred to in an agreement with the Aluminium Corporation, Ltd. (incorporated in 1907) and R. Lawson and A. H. Gibson, the liquidator thereof, and to carry on the business of manufacturers of and dealers in aluminium, electricians, engineers, machinists, fitters, &c. The subscribers (with one share each) are:—A. H. Elliott, 6, Winterbrook Street, Herne Hill, S.E., accountant; A. Harbert, 43, Selby Road, Anerley, S.E., accountant; G. Wilson, 214, Victoria Road, Alexandra Park, N., clerk; W. L. Waite, 28, Wallingford Avenue, North Kensington, W., clerk; W. Newbert, 123, First Avenue, Manor Park, cashier; W. Moir, 60, Broomwood Road, Clapham, S.W., clerk; G. C. Pullman, St. Helens, Hampton Wick, articled clerk. Minimum cash subscription, seven shares. The number of directors is not to be less than four or more than seven; the first are S. G. Bibby, Dashwood House, New Broad Street, E.C.; K. M. Clark, Sudbourne Hall, Orford, Suffolk; E. Manville, St. Stephen's House, Victoria Embankment, S.W.; W. C. Stennett, 116, Victoria Street, S.W.; and W. Williamson-Wylie, Vulcan Works, Johnstone, N.B. No qualification necessary for first directors; of other directors, £500; remuneration, £100 each per annum (chairman, £150) and a share in the profits. Registered office, 34, Old Broad Street, E.C.

Compagnie Generale Electrique de la Champagne, Ltd. (106,408).—This company was registered on December 13th, with a capital of £80,000 in £4 shares, to install and exploit works for the distribution of electric power in the Valley of Guippe, Rheims, and in Aisne, Ardennes, Marne, all in France, and elsewhere, to build works and lines of transport in the department of Marne and the bordering departments, for the production, transportation and distribution of electric power. The subscribers (with one share each) are:—J. C. Bomine, 1, Broad Street Place, E.C., financial agent; M. W. Prentis, 11, Broadhurst Gardens, Hampstead, N.W., gentleman; R. B. M. Wilkins, 21, Therapia Road, East Dulwich, S.E., gentleman; A. O. Warren, 2, Broad Street Place, E.C., gentleman; F. C. Sanders, 1, Broad Street Place, E.C., clerk; H. Bowden, 1, Broad Street Place, E.C., secretary; R. Pilkington, 47, Fetter Lane, E.C., gentleman. Minimum cash subscription seven shares. The number of directors is not to be less than two or more than five; the first are J. Bouchet and H. Lamort (managing director), and others (if any), to be appointed by the subscribers; remuneration of managing director, £240 per annum; of chairman, £150; of others, £100 each per annum. Registered office, 1, Broad Street Place, E.C.

Electro-Metallurgical Syndicate, Ltd. (106,503).—This company was registered on December 17th with a capital of £1,250 in 2s. 6d. shares, to acquire certain options to work and exploit patents, to acquire land and call for electrical power, to adopt an agreement with C. J. Head and W. D. Rock, and to carry on either in connection with the above options or otherwise the business of manufacturers of ferro-chrome or other alloys, &c. The subscribers (with one share each) are:—W. D. Rock, 62, Leadenhall Street, E.C., engineer; H. S. Gain, 42, Lowth Road, Camberwell, S.E., clerk; H. J. Rayment, 42, Chaucer Road, Herne Hill, S.E., clerk; A. E. Davis, 19, Park Road, Spencer Road, New Wandsworth, S.W., shorthand writer; W. R. Chambers, 262, Albany Road, Camberwell, S.E., hosier; F. H. Chamberlain, 69, Prince George's Avenue, Raynes Park, S.W., accountant; Elizabeth A. M. Pratt, 19, Officers' Quarters, The Avenue, Brixton Hill, S.W., typist. Minimum cash subscription, £10. The first directors are not named. Registered office, 25, Victoria Street, Westminster.

Electro-Scrip Sign Co., Ltd. (106,453).—This company was registered on December 15th, with a capital of £1,000 in £1 shares, to acquire the exclusive right to manufacture and deal with a patent luminous sign to be called the "Electro-Scrip" in the United Kingdom and British Dominions. The subscribers (with one share each) are:—A. S. Newmark, 52, Albemarle Road, Beckenham, gentleman; A. Rapoport, 34, Hatton Garden, E.C., diamond merchant. Private company. The number of directors is not to be less than two or more than three; the first are A. S. Newmark, A. Rapoport and E. Klaber; qualification, £50. Registered office, 16, Holborn Viaduct, E.C.

Luminator Water Co., Ltd. (106,460).—This company was registered on December 15th, with a capital of £25,000 in £1 shares, to carry on the business of electricians, engineers, machinists, fitters, machinery manufacturers, &c. The subscribers (with one share each) are:—H. L. Usborne, 22, Austin Friars, E.C., stockbroker; W. F. Sheridan, 22, Austin Friars, E.C., stockbroker. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Registered by Mayo, Elder & Co., 10, Draper's Gardens, E.C.

Hilo Ignition, Ltd. (106,508).—This company was registered on December 17th, with a capital of £50,000 in £1 shares, to acquire certain inventions relating to a system of ignition for internal combustion engines known as the "Hilo" ignition, and to carry on the business of manufacturers of, and dealers in, ignition devices, magnetos, electrical appliances, motors, cars, aeroplanes, accessories, &c. The subscribers (with one share each) are:—C. Leachman, Caversham Lodge, Barnes, S.W., paper maker; A. J. Postans, Sym Park Cottage, Brentford, engineer. Private company. The number of directors is not to be less than two or more than seven; the first are C. Leachman, J. M. Postans and W. Frost; qualification, £1; remuneration, £450 per annum, divisible. Registered office, 17, Fenchurch Street, E.C.

Broughton Machinery Co., Ltd. (106,481).—This company was registered on December 16th, with a capital of £1,000 in £1 shares, to take over the business of a dealer in electrical and mechanical machinery carried on by Martha E. Mercier, at 291, Bury New Road, Broughton, as the Electrical and Engineering Stores. The subscribers (with one share each) are:—A. O. Walker, Trevelyan Buildings, Corporation Street, Manchester, electrical engineer; C. L. Turner, 49, Deansgate, Manchester, consulting engineer. Private company; the number of directors is not to be less than two or more than five; the first are C. L. Turner and S. W. Robinson; qualification, £5; remuneration, £50 per annum, divisible. Table "A" mainly applies. Directors' borrowing powers restricted to the amount of the subscribed share capital. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

Suter's Patents, Ltd. (106,441).—This company was registered on December 14th, with a capital of £1,000 in £1 shares (500 preferred ordinary and 500 ordinary), to carry on the business of electrical engineers, electricians, water, gas and consulting engineers, aeroplane, flying machine, engine and motor manufacturers, tube makers, wire drawers, motor-car, cycle and carriage builders, workers in rubber and other materials, &c. The subscribers (with one share each) are:—F. Suter, 16, Percy Street, W., electrical engineer; J. W. Stephens, 16, Percy Street, W., electrical engineer. Private company. The number of directors is not to be less than two or more than seven; the first are F. Suter and J. W. Stephens; remuneration of managing director not to exceed £1,000 per annum. Registered by H. A. Scott, 53-4, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bryant Trading Syndicate, Ltd. (67,051).—Memorandum of deposit of title deeds, dated November 15th, 1909, to secure £5,000 and a bonus of £500, charged on certain freehold hereditaments in State of Missouri, U.S.A., comprised in Cedar Gap Title Deed. Holder:—W. Jaggard, Cornhill, Bury St. Edmunds, and H. S. Golding, Newmarket.

Small Power Dynamo and Motor Co., Ltd. (103,094).—Charge dated November 22nd, 1909, to secure all moneys, not exceeding £300, for which the mortgagee as guarantor may become liable. Property charged: The company's undertaking and property, present and future. Holder: W. T. Wood, Clarence Buildings, 2, Booth Street, Manchester.

Church Stretton Electric Supply Co., Ltd. (80,857).—Charge dated December 1st, 1909, to secure £235. Property charged: Certain lands, hereditaments and premises. Holder: E. Bond, 43, Thurloe Square, S.W.

Edison and Swan United Electric Light Co., Ltd. —(18,904).—Trust deed dated November 25th, 1909 (supplemental to trust deed dated June 19th, 1900), to secure £100,000 ranking, *pari passu*, with outstanding stock secured by principal deed. Property charged: Certain assets. Trustees: London Trust Co., Ltd., 37, Lombard Street, E.C.

Hindhead and District Electric Light Co., Ltd. (75,361)—Particulars of debentures to secure not more than one-third of the share capital, created October 6th, 1909, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £5,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Consolidated Electric Works and Appliances, Ltd. (101,022).—Issue on December 6th of £300 debentures, part of series created January 12th, 1909, to secure £2,500, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £2,200.

Amazon Telegraph Co., Ltd. (44,532).—Particulars of £300,000 debentures created November 16th, and secured by trust-deed dated December 7th, 1909, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital, but excluding an annual subvention of £17,125 from the Brazilian Government, except so far as the company can, under the terms of its concessions, charge the same. Trustees: Sir. Wm. Cuthbert Quilter, Bart., 11, Great Swan Alley, E.C., and Capt. C. S. Schreiber, Marlesford Hall, Wickham Market.

Marconi's Wireless Telegraph Co., Ltd. (53,403).—A memorandum of satisfaction to the extent of £500 on December 1st, 1909, of mortgage dated September 30th, 1908, securing £1,465 15s., has been filed.

Paignton Electric Light and Power Co., Ltd. (98,437).—Particulars of £5,000 debentures created October 15th, 1909, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £900. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Charing Cross, West End and City Electricity Supply Co., Ltd. (29,129).—Trust deed dated December 9th, 1909 (supplemental to trust deed of March 31st, 1908), to secure £50,000 debenture stock (ranking *pari passu* with the £600,000 covered by the principal deed). Property charged: As per principal deed. Holders: Union of London and Smiths' Bank.

Hove and Worthing Electric Tramways Co., Ltd. (80,239).—This company's annual return was filed on November 26th, when 9 shares had been taken up out of a nominal capital of £100,000 in £5 shares. £45 has been paid. Mortgages and charges: Nil.

Nalder Bros. & Thompson, Ltd. (62,214).—This company's annual return, made up to November 12th, shows 8,256 preference and 11,125 ordinary shares taken up out of a nominal capital of £22,500 in £1 shares (10,000 preference and 12,500 ordinary). £9,381 has been paid, and £10,000 is considered as paid. Mortgages and charges: Nil.

Mansfield and District Tramways, Ltd. (91,130).—This company's annual return was filed on November 30th, when 60,000 preference and 27,836 ordinary shares had been taken up out of a nominal capital of £80,000 in £1 shares (80,000 preference and 50,000 ordinary). £43,611 has been paid, and £44,225 is considered as paid. Mortgages and charges: £70,000.

McKenzie, Holland & Westinghouse Power Signal Co., Ltd. (94,747).—This company's annual return was filed on November 19th, when the entire capital of £20,000 in £1 shares had been taken up. 4s. per share has been called up, and £4,000 has been paid. Mortgages and charges: Nil.

CITY NOTES.

The Schuckert Gesellschaft.

The directors of the Elektrizitäts Gesellschaft vorm. Schuckert and Co. have decided, in connection with the accounts for 1908-9, to dissolve the guarantee fund of £392,000 which was formed in 1902 by an appropriation from the legal reserve fund for the purpose of obviating subsequent losses through depreciation. This has been accomplished by re-transferring £181,600 to the reserve fund by applying the balance of £210,400 to the depreciation of investments; and the former in this way, together with an allocation of £10,780 from the past year's trading, becomes increased to £250,000, or the equivalent of 10 per cent. of the share capital. The undernoted table indicates the principal points in the accounts:—

	1908-9.	1907-8.
Share capital	£2,500,000	£2,500,000
Bond ,, ...	1,995,000	2,065,000
Gross profits	310,190	295,910
Administrative expenses ...	11,915	13,238
Depreciation (general) provision	2,102	1,173
Depreciation on securities ...	16,564	—
Net profits	226,790	193,320
Dividend...	150,000	125,000
,, per cent.	6	5

The gross profits have been derived from investments, lighting and tramway undertakings in the company's possession or control, and from securities. During the year the electricity works and tramway at Regensburg were sold to the local authorities at a profit, as compared with the book value, and the transaction will be brought into the accounts for the new financial year.

Siemens-Schuckertwerke.

The report of the directors for 1908-9 states that the year stood under the influences of the depression which burdened trade and industry. It was only due to the progressive extension in the use of electrical energy that the company was able to report an increase in the value of the orders, a circumstance which was all the more noteworthy seeing that the sale prices of the majority of the products further declined. The falling off of profits, owing to the depression in prices, was only in part recouped by the simultaneous cheapening of raw materials and the improvement in the working equipment. Apart from slight decreases at the beginning of the financial year, the employment in the individual branches of heavy electrical engineering was uniformly good. The accounts show the following figures, those for 1907-8 being added for the purpose of comparison:—

	1908-9.	1907-8.
Share capital	£4,500,000	£4,500,000
Bond capital	980 000	990,500
Gross profits	663,970	750,900
Administrative expenses ...	67,740	64,720
Depreciation provision ...	40,780	133,140
Net profits	513,390	509,740
Dividend	450,000	450,000
,, per cent.	10	10

The share capital is held to the extent of £2,252,500 by the Siemens & Halske Co., and £2,247,500 by the Schuckert Co. It will be observed from the table that although the gross profits diminished, the net profits were greater. This is due to the reduction in the amount provided for depreciation, as the period has expired during which it was necessary to set aside a minimum of £100,000 per annum for this purpose, whilst at the same time the machine tools, machinery and heating and lighting installations, apart from additions during the year, had previously been written down to 1s.

The report states that the deliveries of the German and ex-German works in 1908-9 comprised 52,038 machines, motors and transformers of 1,201,170 KW. as compared with 51,857 and 1,014,225 KW. respectively in 1907-8. It is proposed to transfer manufacturing gradually from Charlottenburg to the Nonnendamm, and the existing machine shop is being enlarged for this purpose. The company developed mathematical methods and apparatus for the protection of high-tension installations against excess pressures, and work was successfully carried out in the improvement of compensated machines for heavy and sudden overloading in the case of rolling mills and ironworks, winding engines,

shaft ventilators and pumps, and fire-damp-proof motors and apparatus, together with driving for the textile, paper and crane industries. The large units already constructed had been surpassed during the year. The output of the automobile works found a ready sale. As the proposed taxation of electricity had been abandoned, the company received important orders from the mining and iron and steel industry, particularly for main winding engines and heavy reversing rolling mill trains. The erection of "overland" central stations both at home and abroad had assumed a noteworthy extent, and was a source of abundant employment. Orders had not been lacking for the execution of new railways and the extension of existing lines, whilst electrical working for mine and similar railways was gaining more ground and afforded good employment. Large orders were received for the Berlin and Schöneberg elevated and underground railway. As the results of the main line Hamburg-Altona-Blankenese had been favourable, the Prussian State Railway Administration had selected as a long-distance railway the Magdeburg-Bitterfeld-Leipsig-Halle line, and, as a beginning, intended to introduce electric traction on the Dessau-Bitterfeld section, a substantial portion of the orders for which had been placed with the company. The latter was also participating in the conversion of the Spiez-Frutigen line, which represented the first portion of the great Alpine line through the Lötschberg tunnel that was in course of construction. The report remarks, in conclusion, that orders in the new financial year have hitherto come to hand to a satisfactory extent, although prices have not advanced, notwithstanding the apparent improvement in the economic situation.

Siemens & Halske.

The directors state in their report for 1908-9 that the general situation of business was not very favourable, and some of the departments were not unaffected by it, as they had to suffer from keen competition and the reserve manifested by important customers, especially local authorities. On the other hand, the more favourable working of other departments had the effect of causing the total results to be considerably better than in the preceding year, the turnover being 15 per cent. greater. The sales of the glow lamp factory, which was enlarged in 1907-8, largely increased during the year, and were also progressing in a satisfactory manner in the new financial year. At the close of the year three automatic telephone exchanges were in course of construction, and the building of benzine motors had been taken up on a large scale. The branch of ozone water installations had experienced a fresh revival by various installations which had been partly carried out and were partly in progress. The Electro-Steel Installation Co. had made a further advance, and the Wireless Telegraph Co. had obtained a considerable success by the development of its new system of sounding sparks. The works for the continuation of the Elevated and Underground Electric Railway in Berlin, from the Spittelmarkt *via* the Alexanderplatz to the Schönhauser Allee, were in preparation, whilst the execution of this railway company's new power station on the Lower Spree had been commenced. It was assumed that as the works in connection with the Schoneberg undergound railway had made considerable progress, the line would be set in operation about the end of 1910, before the expiration of the contract period. The construction of the city and suburban railways in Hamburg was proceeding according to the programme. The following items are extracted from the accounts:—

	1908-9.	1907-8.
Share capital	£3,150,000	£2,725 000
Bond capital	1,328,500	1,348 000
Gross profits	639 870	553,880
Administrative expenses ...	42,250	42,870
Depreciation provision ...	24 050	23,610
Net profits	571,450	484,410
Dividend	378,000	299,750
,, per cent.	12	11

The report states further that the Austrian Siemens-Schuckert Works Co. had increased its dividend for the past year to 5 per cent., whilst the Russian Siemens & Halske Co. and Siemens Bros. and Co. had again distributed 4 per cent. It is added that a further expansion in orders has taken place in the new financial year.

Stock Exchange Notices. — The Committee have appointed special settling days as under:—

January 6th.—New York Telephone Co.—Scrip, fully paid, for £2,000,000 4½ per cent. first and general mortgage 30-year bonds (London issue).

And ordered the above and the following to be quoted in the Official List:—

Charing Cross, West End and City Electricity Supply Co.—Further issue of £182,570 4½ per cent. debenture stock.

Direct West India Cable Co., Ltd.—The directors have declared an interim dividend of 6 per cent. per annum (1s. 6d. per share) free of income-tax, on the ordinary shares for the past half-year.

Halifax and Bermudas Cable Co.—The directors have declared an interim dividend of 5 per cent. per annum (2s. 6d. per share), free of income-tax, on the ordinary shares for the past half-year.

The Paris Compressed-Air Co. — It was recently mentioned that a syndicate of French banks had concluded negotiations for the repurchase of a considerable number of shares held by German financial institutions in the Compagnie Parisienne de l'Air Comprimé or the Popp Company, there only remaining outside the transaction a block of shares possessed mainly by the firm of Sal. Oppenheim & Co., of Cologne. The operation was completed at the beginning of November, when the shares changed hands, but the satisfaction at this apparent nationalisation of the Popp Compressed Air and Electricity Co. has been somewhat tempered by the knowledge that has now become public that the shares still in Teutonic hands number about 6,400, and are founders' shares. As such the shares are entitled to 41 per cent of the net profits after a dividend at the rate of 6 per cent. has been paid, and they also carry the right of subscription at par for one third of any new issue of shares by the Paris company. The French interests now propose to acquire these particular shares; negotiations on the subject are proceeding, and are expected to be completed by the end of this month between the company itself, instead of the banking syndicate, as in the case of the ordinary shares, and the German holders.

Electrical Securities Trust, Ltd.—The accounts for the year ended November 14th show a loss, after providing for debenture interest, of £5,442, increasing the debit to profit and loss brought forward to £10,485. During the year the South-Western Traction Co., of Canada, in the first mortgage debentures of which this company is interested to a large extent, was placed in the hands of a receiver, and the property was sold in October last. The amount which the company is entitled to in respect of its holding is, approximately, £50,000, and, as soon as this money has been received, says a financial daily, meetings of the debenture-holders and the shareholders will be called to consider its distribution and the future of the company.

Houghton-le-Spring and District Electric Lighting Co., Ltd.—Mr. A. W. Tait presided at Basildon House, E.C., on Wednesday last week, over the annual meeting of the above company. In the absence of any shareholders, the following report was adopted, on the motion of the Chairman, seconded by Sir Douglas Fox:—The loss on the working of the year ended December 31st, 1908, is £133, after charging interest amounting to £394. To this loss has been added the cost of the investment in the S.M.H. Tramway Syndicate, Ltd., written off, amounting to £1,000, making the loss carried to the balance-sheet £1,133. The sales of energy during the year show considerable increase over those of the previous year, and still further progress has been made during the year 1909. In accordance with arrangements made in conjunction with the Durham Collieries Electric Power Co., Ltd., Mr. H. R. Hogg and Captain Osborne resigned from the board, and Messrs. L. D. Cunliffe and T. O Callender were appointed. Mr. H. van Brienen Collet was elected as an additional director.

Howard & Bullough, Ltd.—An interim dividend of 10 per cent. per annum (6d. per share), free of income-tax, has been declared on the ordinary shares for the past quarter.

Sunderland District Electric Tramways, Ltd.—The accounts for the 12 months ended October 31st, 1909, show the company to be in a better position than in any previous year. After providing for interest on the prior lien bonds and first and second mortgage debentures and loans, viz., £9,730, there is a loss of £780, bringing the loss to date up to £14 604. During the year the traffic receipts fell off by £1,319, but against this a saving was effected in working expenses of £2,108. The decrease in traffics is attributable to the exceedingly unsatisfactory state of trade in the district served by the company during the past year, following on the long shipbuilding strike of the previous year. In addition, the unfortunate weather of the past summer contributed to the decrease. Signs of improving trade are now discernible in the district, and the directors are hopeful that the coming year will show a very considerable improvement in the company's position.

Calcutta Electric Supply Corporation, Ltd.—The *Financial Times* says that the negotiations for the placing privately of £100,000 of the cumulative 5 per cent. £5 preference shares of the Calcutta Electric Supply Corporation, which were reported to have fallen through, are still proceeding, and will, it is believed, prove successful. It appears that the technical legal difficulty which has occurred is being surmounted by mutual concessions between the company and its friends.

Electric Conversion Syndicate, Ltd.—The report states that during the year to September 30th the liabilities have been reduced by £2,815, and the annual expenditure has been brought down so as to be covered by the incomings. A scheme for the continuation and rehabilitation of the company has been prepared, and will be laid before the members at an early date, as soon as the necessary guarantees now under negotiation can be completed. A contemporary adds that the directors have before them several propositions by which, if carried through, a satisfactory amount in commissions can be earned, and that without requiring any serious amount of capital to finance them.

France.—The balance-sheet of La Compagnie d'Energie Electrique du Centre, of Paris, for the last financial year shows a net profit of £12,405, compared with only £8,246 in the preceding 12 months.

Manx Electric Railway Co., Ltd.

The report of directors to September 30th, 1909, shows that the gross receipts amounted to £32,745, and the gross expenditure to £16,509, leaving £16,237, plus £1,050 brought forward, = £17,287. Deduct debenture interest £9,000, interim dividend of 2¾ per cent. on preference shares paid September 30th, 1909, £3,580, leaving £4,707. Deduct, balance of preference share dividend due in respect of the year ended September 30th, 1909, £3,580, leaving a balance of £1,126, which the directors propose carrying forward to next year. During the year the capital expenditure had been £20. The net result of the year's working has been injuriously affected by the bad weather, as is the case with all undertakings in the island, and the passengers carried during the 12 months totalled only 518,655, at compared with 527,986 during the previous 12 months, a decrease of 9,331. The receipts were £32,745, as compared with £33,735 in the previous year, whilst the working expenses amounted to £16,509, comparing with £16,734 in the previous year. The ratio of working expenses to receipts has been 50·3 per cent. in 1909, as compared with 49·6 per cent. in 1908.

Mr. A. G. Boscawen (chairman) presided on Tuesday, December 21st, at the offices, 3, Finch Lane, E.C., over the seventh annual general meeting of the above company.

The Chairman, in moving the adoption of the report (as above), pointed out that in the past it had been usual to receive the accounts at an extraordinary meeting, but under the new Companies' Act they were enabled to hold that meeting there, and it would be unnecessary to hold a meeting in Douglas in the spring. It was perfectly obvious that the accounts were a disappointment to the board and shareholders alike. The receipts during the year showed a total decrease of £989 4s. 4d. The decrease in the revenue from passengers was £1,293 19s., but there was an increase in goods and sundry receipts of £304 14s. 8d. On the other hand, the working expenses were £224 19s. 8d. lower. Owing to the decrease in the receipts there was a slight increase in the ratio of working expenses to receipts, viz., 50·3, against 49·6. The mileage had considerably decreased, both as regarded passengers and goods. There was a decrease in passenger mileage of 14,671¼ miles and in goods of 922½ miles, which showed that the board and the officers had taken every step to decrease the mileage in view of the falling receipts. The decrease in the number of passengers carried was 9,331. They were showing practically the same receipts per train-mile as last year, although the number of passengers was considerably smaller, and this was due to the judicious reduction in the mileage run, or, in other words, to careful and economical working. Of course, the principal cause for the falling off was the bad weather experienced in the island, for they had had 35 completely wet days during the season against an average of 26 in the last four years. Unfortunately for them the two wettest months were July and August, the two months in which they expected to make money; June was comparatively fine, and in September there was a great improvement. But for this improvement things would have been much worse than they were. He could only say that every step was taken by the officers and the board to secure as much traffic as possible, and it was a fair comparison to make to show that similar undertakings in the island suffered quite as much, if not more than they did. The Douglas Southern Electric Tramway Co.'s receipts were £222 down compared with last year, notwithstanding an increase of mileage of 2,521 miles, whilst the receipts of the Isle of Man Railway Co. were down by £1,213. It was quite true that the returns of the Isle of Man Steam Packet Co. showed that there were more visitors to Douglas, but these returns were somewhat illusory, because the increase was due to day trippers and week-end visitors, and, of course, such visitors were not nearly so much use to them as those who came and resided some weeks in the island. At the same time, they took every step to obtain as much advantage as was possible from trippers, and in nearly every case through bookings were arranged from this side. Another cause which operated against them was the decreased spending capacity of the people who came, as compared with previous years, which was attributable to the long-continued bad trade, especially in Lancashire and Yorkshire. The receipts from each passenger over the line averaged 13·5d., against 13·8d., which was a decrease of ·3d. during the year. The net result during the past year enabled them to pay the debenture interest and the preference dividend, and to carry forward £1,126; but they were unable to place anything to the reserve fund for special renewals. That account, however, stood at £5,316, and he wanted to assure the shareholders that during the year the line had been well kept up in every respect. Sir W. Vaudrey and himself visited the whole line during the month of August, and they were convinced that everything had been done to maintain it and make it attractive in every way. It was well advertised, and the care which had been exercised showed that their officers were doing everything they possibly could to make a trip along the line attractive. It was a great matter for regret that nothing further had been done towards the electrification of the front, and the better lighting of the town of Douglas, and he was bound to say that in the opinion of the board, one reason why the residential visitors to the island had not increased was because Douglas and the island, to some extent, was falling behind in the competition with such places as Blackpool. He was convinced that the Corporation of Douglas would be taking a wise step if they improved the lighting of the town and replaced the antiquated system of horse tramways along the front with electric trams.

Mr. B. E. Greenwell seconded the motion.

Mr. Holford asked whether there was a prospect of the ordinary shareholders ever receiving a dividend.

The Chairman said he certainly thought so, and, in fact, they received one two years ago.

Mr. Holford: It was very small.

The Chairman said that was true, but had it not been for the two disappointing years that dividend would have been maintained and increased. Their first duty was to maintain the line in an efficient state, but he hoped that with better trade they would do a good deal better next year.

The motion was then carried, and the retiring directors and auditors were re-elected.

Mr. Tiarks proposed a vote of thanks to the board, and Mr. Holford, in seconding, expressed the hope that the board would be able to induce the Douglas Corporation to have the tramways on the front electrified.

The Chairman said they had been doing all they could to come to some arrangement with the Corporation, but their negotiations had broken down through no fault of the board's.

Durham Collieries Electric Power Co., Ltd.

Mr. A. W. Tait (chairman) presided at the ordinary general meeting of the above company at the offices, Basildon House, Moorgate Street, E.C., on Wednesday last week, when the following report was submitted:—The directors submit accounts made up to September 30th, 1909, covering a period of 18 months from March 31st, 1908, which was the date of the previous balance sheet. The trading account shows a profit of £5,266, but after charging head office expenses, rent and royalty to the Sunderland District Tramways, Ltd., and writing off a bad debt of £7,363, there is a debit of £8,787, to which has to be added the prior lien debenture interest and first mortgage debenture interest, bringing the total loss for the period up to £21,714. The sales of current during the period show considerable improvement, and, owing to contracts which have been made with further consumers and to the extension of the demand of existing consumers, further progress in this respect is to be expected. The arrangements suggested in the previous report for an issue of second mortgage debentures could not be carried out, and, owing to the financial position of the company, it was necessary to convene meetings of debenture-holders, which were held on December 14th, 1908, and powers were taken for the creation of £50,000 prior lien bonds, the proceeds of such issue to be applied in the improvement of and for extensions to the company's distribution system. The debenture-holders also agreed to waive their foreclosure rights in respect of interest on the first mortgage debentures for a period of five years to December 31st, 1913, on the condition that any net profits earned by the company during that period, after meeting the prior lien interest, should be distributed among the debenture-holders. Arrangements were also made at the same time with the outstanding creditors of the company, under which they accepted first mortgage debentures at par in satisfaction of their claims against the company. An agreement was also entered into, with the consent of the debenture-holders, with the Newcastle-upon-Tyne Electric Supply Co., Ltd., and the County of Durham Electric Power Supply Co., under which the former company agreed to operate the company's generating station at Philadelphia, and to supply any current which may be required by its consumers at fixed prices, and also to manage the company's distribution system on a sliding scale according to the output; these arrangements to last for a period of 42 years from January 1st, 1909. In respect of this agreement, the County of Durham Co. has given certain rights and privileges to this company with regard to the supply of power to consumers within specified areas. In connection with these arrangements, Messrs. J. S. Bergheim, H. R. Hogg and C. A. Osborne retired from the board, and Messrs. H van Brienen Collet, L. D. Cunliffe and T. O. Callender were appointed by the debenture-holders, the Newcastle Co., and the creditors respectively, to fill the vacancies. The appointment of these gentlemen will be submitted for confirmation to the meeting. Mr. A. W. Tait and Sir Douglas Fox offer themselves for re-election.

STOCKS AND SHARES.

Tuesday Afternoon.

To the year 1909 belongs the honour of being better than its predecessors for half a decade, from the Stock Exchange point of view. The honour may be a little equivocal, seeing how barren the recent years have turned out, but nevertheless the fact remains. Amongst electricity stocks and shares the 12 months have produced much activity in foreign power, traction and lighting issues, but in domestic securities they have proved a period of much quietude. Home Rails in particular have been neglected, and how slender are most alterations on balance, this table shows:—

Stock.	Dec. 31, 1908.	Dec. 28, 1909.	Rise or fall.
Central London Ord.	65	64	— 1
,, Pref.	85	86	+ 1
,, Def.	51	46	— 5
City & South London	27	32½	+ 5½
Great Northern & City	¾	1	+ ¼
Metropolitan	37	40	+ 3
Metropolitan District	14	18½	+ 4½
,, ,, 6 per cent. Deb.	123½*	144	+20½
Baker Street & Waterloo Deb.	95	98	+ 3
Charing Cross and Euston Deb.	85*	96	+11
Gt. Northern, Picc. & B. Deb.	92*	96	+ 4

Quiet as business has been in Home Railway stocks, in Electricity Supply shares the year brought greater quietude still, and the comparative quotations of leading shares are as follows:—

Ordinary shares.	Dec. 31, 1908.	Dec. 28, 1909.	Rise or fall.
Brompton and Kensington	8½	7½	— 1
Charing Cross and Strand	4⅝	4⅜	— ⅛
Chelsea	4	3⅞	— ⅛
City of London	10½	10½	—
County of London	10⅞	10¾	—
Edmundson's Pref.	⅞	¾	— ⅛
Kensington and Knightsbridge	8	7⅞	— ⅛
London Electric	1 1/16	1 1/16	+ 1/32
Metropolitan	5¼	4¼	— 1
Notting Hill	12⅛	12⅜	+ ¼
St. James' and Pall Mall	8⅝	8½	— ⅛
Smithfield	⅞	1⅞	+ 1
South London	2 1/32	2 1/16	+ 1/32
Urban Pref.	1 3/32	1⅛	— 1/32
Westminster	8⅛	8¼	+ ⅛

The development of metal-filament lamps has made serious inroads upon profits in a certain number of cases, but the falling off is simply a matter of recoiling in order to prepare for a bigger leap forward, and the new year should bring its reward—or a first instalment of reward—to the supply companies in consequence of the increased demand for an electric illuminant demonstrably cheaper than gas.

The telegraph market has experienced its usual amount of more or less harmless shocks, and the result of the year's working is, on the whole, satisfactory to proprietors. The heavy rise in Mackay Companies' Common is due, of course, to operations from the other side of the Atlantic.

Stock or share.	Dec. 31, 1908.	Dec. 28, 1909.	Rise or fall.
Amazon	2⅝	3⅝	+ 1
Anglo-American Deferred	15⅝	22	+ 6⅜
Cuba	8	8⅛	+ 1/16
Direct Spanish	3½	3½	—
Direct U.S.A.	13⅛	13½	+ ⅜
Eastern	130⅛	135⅛	+ 5
Eastern Extension	11½	12	+ ½
Great Northern	31	30	— 1
Globe Telegraph and Trust	10¼*	10½	+ ¼
Indo-European	53½	52	— 1½
Mackay Common	76	94	+18
do. Pref.	72½	79	+ 6½
Marconi	9/16	½	— 1/16
Western	12⅜*	13⅜	+ 1
West Indian and Panama	9/16	11/16	+ 1/16
do. First Pref.	7⅞	9	+ 1¼
do. Second Pref.	8	8½	+ ½

Putting a few telephone issues by themselves, the annexed comparisons appear:—

Stock or share.	Dec. 31, 1908.	Dec. 28, 1909.	Rise or fall.
American Telegraph and Telephone	130*	145	+ 14½
Chile	8¼	7 1/16	— 1/16
Monte Video	5/16	7/16	— 1/16
National Preferred	109½	107¼	— 2¼
,, Deferred	117½	124	+ 6½
Oriental	1⅜	1 7/16	+ 1/16
United River Plate	6½	7⅛	+ ⅛

The activity in tramway, traction and power descriptions has already been mentioned, and, for convenience sake, the accompanying catalogue embraces a number of the best known issues in the several sections:—

Stock or share.	Dec. 31, 1908.	Dec. 28, 1909.	Rise or fall.
British Columbia Electric Rly. Def.	136½	143	+ 6½
,, ,, ,, Pref.	118	123	+ 5
British Electric Traction	1 1/16	13/16	— 1/16
,, ,, ,, Pref.	3⅛	2 15/16	— 1/16
Canadian General	107*	114½	+ 7½
Calcutta Trams	4⅜	4⅜	—
Cape Trams	1/16	1/16	+ 1/16
London United Pref.	4⅜*	2¼	— 2⅛
,, ,, Deb.	68*	61½	— 6½
Mexico Trams	136½	124	—12½
Mexican Light and Power	76	69	— 7
Rio Trams	84¼	92	+ 7¾
Sao Paulo	159*	154	— 4½
Shawinigan Water	82½	104	+21½

The final list must comprise some of the most important manufacturing and "miscellaneous" companies. In their shares the changes during the year have been decidedly varied, as these statistics illustrate:—

Stock or share.	Dec. 31, 1908.	Dec. 28, 1909.	Rise or fall.
Babcock & Wilcox	8⅛	4⅜	+ ⅛
British Aluminium Ordinary	2 1/16	2	— 1/16
Do. "A" Preference	4	3⅞	— ⅛
British Insulated	6⅜	6 1/16	— 5/16
British Westinghouse Preference	2	1 15/16	— 1/16
Do. do. 4 per cent. Deb.	42¾	50*	+ 6¼
Brush 4½ per cent. Debentures	67½	43½	—24
Callender's Ordinary	9⅛	10⅜	+ ¼
Castner-Kellner	1 7/16	2 1/16	+ 5/16
Dick, Kerr	1 7/16	1 1/16	— 5/16
Edison & Swan "A" fully	2	1 15/16	— 1/16
General Electric Preference	7⅜*	8⅜	+ 1
Henley's Ordinary	12	12⅜	+ ⅜
India-Rubber	16⅜*	16⅛	— ⅛
Telegraph Construction	31½	35⅝	+ 3⅛
Willans & Robinson	⅞	¾	— 1/16
Do. Preference	2 1/16	2	— 1/16

* Ex dividend.

The Old Year might have been worse: the New Year holds prospects for investment securities that are admittedly bright. It is in the hope that the prices for all stocks and shares which they may hold, or buy, may advance in value during 1910 that the readers of these notes are tendered good wishes for a prosperous and successful New Year.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open. Inc.
Aberdeen	Dec. 22	2,365	— 178	29	41,459	— 1,087	.. ..
Ayr	,, 25	351	— 9	32	10,808	— 156	8 ..
Bath	,, 22	1,290	— 52	51	38,934	— 1,285	.. ..
Belfast	,, 24	8,025	+ 19	37	147,251	+ 5,310	37 ..
Birkenhead	,, 26	2,193	+ 61	38	41,421	— 880	13·63 ..
Birmingham Corp.	,, 18	13,806	+ 565	38	248,922	+ 7,299	.. ..
Blackburn	,, 22	1,762	— 199	39	42,628	— 1,392	14·32 ..
Blackpool Corp.	,, 23	622	— 61	..	49,947	+ 4,083	.. ..
Blackpool-Fleetw'd	,, 11	450	— 4	23	22,315	+ 1,967	.. ..
Bolton	,, 19	4,286	— 16	38	88,279	+ 288	26 ..
Bournemouth	,, 22	2,624	— 84	38	64,524	+ 288	21·95 ..
Bradford	,, 18	8,956	+ 226	37	183,370	+ 6,138	54·81 ..
Brighton	,, 26	1,589	— 80	39	38,400	+ 1,619	9·5 ..
Bristol	,, 24	11,430	+ 737	..	..	..	.. ..
Brit. Elec. Trac. Co.							
Airdrie	Dec. 17	409	— 9	50	10,940	— 139	3·65 ..
Barnsley	,, 17	320	— 9	,,	8,432	— 881	.. ..
Barrow	,, 17	413	— 3	,,	11,563	— 596	5·37 ..
Cavehill	,, 17	99	— 6	,,	4,197	— 110	.. ..
Devonport	,, 17	688	— 262	,,	18,363	— 4,952	8·85 ..
Gateshead	,, 17	1,967	+ 9	,,	49,856	— 522	11·25 ..
Gravesend	,, 17	383	+ 28	,,	10,521	+ 54	6·5 ..
Greenock	,, 17	955	+ 64	,,	27,655	+ 1,592	7·25 ..
Hartlepool	,, 17	422	+ 25	,,	11,766	— 50	6·72 ..
Kidderminster	,, 17	178	+ 8	,,	5,352	— 136	.. ..
Leamington	,, 17	265	— 4	,,	8,792	+ 208	.. ..
Merthyr	,, 17	371	— 57	,,	10,454	— 239	2·9 ..
Metropolitan	,, 17	11,916	+1,153	,,	311,726	+24,011	22 ..
Middleton	,, 17	528	— 55	,,	16,555	— 1,038	8·5 ..
Mid. Joint Com'tee	,, 17	11,180	+ 108	,,	286,342	— 624	.. ..
Oldham—Ashton	,, 17	1,004	— 40	,,	27,971	— 1,233	9·13 ..
Peterborough	,, 17	191	— 4	,,	5,885	— 435	5·31 ..
Potteries	,, 17	9,670	— 55	,,	90,408	— 358	29 ..
Rothesay	,, 17	73	+ 2	,,	9,915	+ 118	2·75 ..
Southport	,, 17	422	— 18	,,	14,195	— 464	8·17 ..
S. Metropolitan	,, 17	1,366	+ 7	,,	39,732	— 583	.. ..
Swansea	,, 17	1,877	+ 132	,,	48,931	+ 1,737	12·5 ..
Tynemouth	,, 17	266	+ 3	,,	11,986	+ 851	3·75 ..
Weston-s Mare	,, 17	46	— 6	,,	7,165	+ 393	3 ..
‡Worcester	,, 17	480	— 8	,,	13,833	— 147	5·75 ..
Wrexham	,, 17	167	— 14	,,	4,895	— 218	.. ..
Yorks. Wool. Dist.	,, 17	1,749	+ 100	,,	46,157	+ 603	17 ..
Miscellaneous	,, 17	377	+ 12	,,	10,438	— 785	.. ..
Burnley	,, 25	2,238	— 231	..	..	..	.. ..
Burton-on-Trent	,, 26	516	— 6	39	10,335	— 214	6·63 ..
Bury	,, 19	1,891	— 65	37½	43,870	— 418	23·6 ..
Cardiff	,, 18	4,071	— 98	37	83,565	+ 1,126	.. ..
†Carlisle	,, 18	135	— 21	..	8,211	— 464	.. ..
†Chatham and Dist.	,, 16	724	— 85	50	40,981	+ 1,563	14·98 ..
Cork	,, 23	895	— 75	51	22,924	— 718	9·89 ..
Croydon	,, 10	3,025	+ 556	..	57,674	+ 5,235	11·25 4·75
†Darlington	,, 18	172	— 12	38	7,010	— 501	.. ..
Darwen	,, 17	442	— 5	37	9,331	— 103	4·36 ..
Dover	,, 18	314	— 4	38	8,078	— 410	4·75 ..
Dublin	,, 24	10,719	— 20	..	139,756	+ 1,864	54·25 ..
Dundee	,, 22	2,210	— 83	31½	37,383	— 821	15·5 ..
†East Ham	,, 18	942	+ 34	37½	37,853	+ 4,561	8·52 ·77
Exeter	,, 24	566	— 18	39	13,009	+ 557	.. ..
Glasgow	,, 25	38,049	— 505	..	501,190	— 9,811	94½ 5
†Hastings	,, 16	640	— 71	..	..	..	.. ..
†Huddersfield	,, 18	1,694	+ 94	37	62,755	+ 2,843	23·5 ·5
Hull	,, 25	2,507	+ 168	33	100,261	+ 4,088	14·5 1·5
Ilkeston	,, 22	232	— 15	38	5,160	— 263	.. ..
†Ipswich	,, 18	340	— 29	38	15,312	+ 161	10·5 ..
Kilmarnock	,, 18	258	— 31	31	4,539	— 199	4·25 ..
Lancashire United	,, 22	2,098	— 190	51	66,417	— 934	.. ..
Leeds	,, 18	12,908	+ 333	37	258,651	+ 7,369	.. ..
Leicester	.. ..	..	..	..	..	..	.. ..
Leith	,, 25	1,014	+ 44	32	19,432	+ 2,236	9 3
Liverpool	,, 18	21,521	+ 125	50	539,642	— 1,356	.. ..
‡L.C.C.	,, 11	38,298	—8,064	..	1,355,055	+64,980	.. ..
London United	,, 25	10,772	— 468	..	306,718	—29,334	.. ..
†Lowestoft	,, 18	161	+ 10	12	1,931	+ 30	3·5 ..
Manchester	,, 25	28,683	—1,302	39	578,334	— 9,247	.. ..
†Newcastle	,, 18	3,885	— 8	..	146,617	— 1,215	14·5 ..
Newport	,, 18	1,215	+ 9	38	24,844	— 1,293	14·5 ..
Oldham	,, 26	3,059	— 880	39	71,671	— 5,699	28·75 ..
†Pontypridd	,, 18	372	— 11	37½	15,569	+ 1,066	5·5 ..
Portsmouth	,, 18	3,146	— 100	38	79,814	— 2,282	14·5 ..
Preston	,, 22	1,276	— 134	..	..	..	.. ..
†Rotherham	,, 16	572	+ 1	37	21,952	— 1,026	12 2
Salford	,, 20	8,464	— 283	37½	172,379	— 4,675	.. ..
†Sheffield	,, 19	5,594	+ 84	38½	216,901	+ 2,328	.. ..
Southampton	,, 22	2,008	— 83	38	41,100	— 356	.. ..
†Southend-on-Sea	,, 15	342	+ 47	37	20,332	+ 2,662	.. ..
South Shields	,, 25	1,080	— 48	38½	21 827	— 18	.. ..
†Swindon	,, 8	126	+ 12	37½	211,307	+ 2,244	.. ..
Tyneside	,, 22	714	— 70	25	10,705	+ 248	.. ..
Wallasey	,, 26	1,603	— 52	38½	85,676	+ 639	.. ·72
Walthamstow	,, 25	1,210	+ 42	39	25,623	+ 605	9 ..
West Ham	,, 16	4,549	+ 221	37	87,470	+ 5,141	15·25 ·63
†Wolverhampton	,, 15	880	+ 100	37	31,264	+ 290	14·25 1·75
Baker St.-Waterloo	,, 25	7,125	+ 735	25	79 610	+ 3,000	4·25 ..
Cen. London Rly.	,, 25	11,818	+1,099	25	133,792	—41,840	6·32 ·55
Char. +, Bus. Hamp.	,, 25	7,785	+ 475	25	94,030	— 9,250	7·75 ..
City & S. Lon. Rly.	,, 26	5,882	+ 887	25	79,626	+ 3,179	7·3 ..
Dublin-Lucan Rly.	,, 24	224	— 84	25	3,557	+ 6	7 ..
G.N. and City Rly.	,, 25	3 095	+ 205	25	34,185	+ 449	3.5 ..
G.N., P'y, & Brmtn.	,, 25	19,210	+1,210	25	136,535	+ 6,770	9·25 ..
†L'pool Overh'd Rly.	,, 19	1,247	— 88	24	34,579	— 163	6·8 4·3
†Llandudno-Col. Bay	,, 17	94	— 3	9½	251	— 4	.. ..
†Mersey Railway	,, 18	2,099	+ 78	24	47,007	+ 1,719	4·5 ..
Metropolitan Rly.	,, 26	36,510	+2,154	..	410,382	+ 49	24·5 ..
Met. District Rly.	,, 25	21,825	+2,615	25	260,419	+15,490	24 ..
Anglo-Argentine	,, 23	87,259	+6,555	..	2,028,310	+128,946	.. ..
§Auckland	,, 8	14,816	+1,202	48	164,769	+14,899	22·3 1·33
Bombay (B.E.T.)	Nov. 25	11,146	+ 919	47	119,870	+ 6,259	.. ..
§Brisbane	,,	16,170	+1,666	..	..	..	.. ..
§Brit. Columbia Rly.	..	..	..	..	..	..	.. ..
†Calcutta	Dec. 18	3,468	+ 157	..	..	..	.. ..
§CapeElectricT.Ld.	..	..	..	..	..	..	.. ..
§Kalgoorlie, W.A.	..	3,899	..	..	41,472	..	20·5 ..
Madras	Dec. 15	1,405	+ 221	..	29,720	+ 1,511	.. ..
§Lisbon	..	..	..	..	..	..	.. ..
Perth (W.A.)	Dec. 24	3,498	+ 184	..	72,988	+ 1,059	28 2

* Compared with the corresponding period of 1908. † One week only.
‡ Includes horse, steam and other receipts. § One month.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1905.	1906.	1907.	1908.	Closing Quotations Dec. 21st.	Closing Quotations Dec. 28th.	Business done week ended Dec. 28th, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent.
26,000	Amazon Telegraph Co.'s shares, Nos. 1 to 26,000	£10	Nil	Nil	Nil	Nil	8⅜ – 8⅝	8⅜ – 8⅝	..	..	..	£ s. d. Nil.
136,700	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	£100	5 %	5 %	5 %	5 %	100 – 103	100 –103	..	..	..	4 17 1
$121,561,400	American Telephone & Telegraph, Cap. Stock	$100	7¼%	8 %	8 %	8 %	144 –146	144 –146	..	..	–1	5 9 0
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 23,000 and 58,001 to 75,000	$1000	4 %	4 %	4 %	4 %	96 – 98	96 – 98	..	..	..	4 1 8
558,460	Anglo-American Telegraph	Stock	8½%	8½%	8½%	£3 4s.	60 – 62	60 – 62	..	..	..	5 8 4
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	100 –101	100 –101	100⅜	100	..	5 18 0
3,220,770	Do. do. do. Deferred	Stock	1%	12½%	1 %	£1.	21⅜ – 22	22 – 22½	22	21½	+ ⅛	1 14 8
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	101 –103	101 –103	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	£5	8 %	8 %	8 %	8 %	7⅞ – 8¼	7⅞ – 8¼	..	..	..	4 18 6
2,431,350	Commercial Cable, Sing. 600 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	86 – 88⅜	86 – 88	87⅛	86⅛	— ⅛	4 13 0
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	8⅜ – 9¼	8⅜ – 9¼	..	..	..	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 – 19	17 – 18	..	..	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	£5	4 %	4 %	4 %	4 %	3 – 3¼	3 – 3¼	..	..	..	5 14 8
6,000	Do. do. 10 % Cum. Pref. ..	£10	10 %	10 %	10 %	10 %	8 – 8¼	8 – 8¼	..	..	..	6 5 0
80,000	Do. do. 4½ % Debs.	£20	4½%	4½%	4½%	4½%	100½–102½	100½–102½	..	..	..	4 7 10
60,710‡	Direct United States Cable	£20	4½%	4½%	4½%	4½%	13 – 13½	13 – 13½	..	..	..	6 4 7
59,500‡	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 –102	100 –102	..	..	..	4 7 10
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	133 –136	134 –137	126½	135	+1	5 2 2
2,000,000	Do. 8½ % Pref. Stock..	100	8½%	8½%	8½%	8½%	85 – 87	85 – 87	..	..	+ ½	4 0 6
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	102 –104	102 –104	..	..	..	3 16 11
800,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	7 %	11½ – 12½	11½ – 12½	..	..	..	5 14 3
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 –104	102 –104	..	..	..	3 16 11
200,000‡	East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.) 1 to 3,000	£5	4 %	4 %	4 %	4 %	100 –102	100 –102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5⅓%	5⅓%	5⅓%	5⅓%	10½ – 10⅝	10½ – 10⅝	10⅜	..	..	5 7 0
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	13½ – 14	13½ – 13⅝	13⅜	..	..	4 7 3
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	24%	20 %	20 %	18 %	29½ – 30½	29½ – 30½	..	..	— ½	5 18 0
5,000‡	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 –102	100 –102	..	..	..	4 8 3
17,000	Indo-European Telegraph	£5	18 %	18 %	18 %	18 %	51 – 53	51 – 53	..	..	..	7 1 6
$41,380,400	Mackay Companies Common	$100	2 %	3½%	4 %	4 %	93 – 95	93 – 95	..	..	–2	4 4 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	78 – 80	78 – 80	..	..	+2	5 0 0
894,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜ – ½	⅜ – ½	10/7½	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	£1	5 %	6 %	6 %	6 %	⅜ – ½	⅜ – ½	16/-	..	..	6 8 0
86,492	Do. do. do. 5 % Pref. ..	£1	5 %	5 %	5 %	5 %	⅜ – ½	⅜ – ½	..	..	..	5 6 8
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106½ –108	106½ 108	..	..	..	5 11 1
3,725,000	Do. do. Def. Stock	100	5 %	5 %	6 %	6 %	123 –125	123 –125	124½	123½	+1	4 16 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10½ – 11	10½ – 11	..	..	..	5 9 1
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10¼ – 10½	10¼ – 10⅝	..	..	+ ⅛	5 12 1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	£5	5 %	5 %	5 %	5 %	5⅛ – 5⅛	5⅛ – 5⅛	..	..	..	4 8 7
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	99½ - 100½	99½ –100½	..	..	+ ½	3 9 8
1,983,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100½ –102½	100½ –102½	..	..	+ ½	3 18 1
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	£1	7 %	7 %	8 %	8 %	1⅜ – 1½	1⅜ – 1½	..	..	..	5 5 9
50,000	Do. do. do. 6 % Cum. Pref... ..	£1	6 %	6 %	6 %	6 %	1⅞ – 1⅞	1⅞ – 1⅞	..	..	..	4 14 9
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	87½ – 89½	87½ – 89½	..	..	..	4 9 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100 –102	100 –102	..	..	..	3 18 5
11,889‡	Reuter's	£5	5 %	5 %	5 %	5 %	7⅜ – 8½	7⅜ – 8½	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	101 –103	101 –103	..	..	..	4 7 10
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 –132	129 –132	130	..	..	4 7 5
120,000	United River Plate Telephone	£5	8 %	8 %	8 %	8 %	7 – 7½	7 – 7½	7⅛	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	£5	5 %	5 %	5 %	5 %	5½ – 5⅝	5½ – 5⅝	..	..	..	4 6 11
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2½	Nil	2½%	2½%	2½%	1⅜ – 1⅝	1⅜ – 1⅝	27/6	..	..	3 16 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 –102	100 –102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980.. ..	10	7 %	7 %	7 %	7 %	13½ – 14	13⅜ – 14⅛	14	13½	+ ⅛	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 –105	103 –105	..	..	..	3 16 2
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜ – ½	⅜ – ½	..	..	..	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	5 %	8 %	6 %	6 %	8½ – 9½	8½ – 9½	..	..	..	6 9 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	£2 6	15 %	8 – 9	8 – 9	..	..	..	6 13 4
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	102 –104	102 –104	..	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000	£5	..	..	..	..	4⅜ – 4⅞	4⅜ – 4⅞	95/-	93/1½	..	£ s. d. 5 2 7
800,000	Do. 5 % 2nd Pref., 800,001 to 1,800,000	£5	..	..	..	..	4⅜ – 4⅝	4⅜ – 4⅝	..	..	..	5 8 1
978,230	Do. 4 % Deb. Stock	Stock	..	..	..	4 %	92 – 93½	92 –93½	93½	92⅜	..	4 5 7
382,387	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 –107	104 –107	..	..	..	4 13 6
380,000	Babcock & Wilcox, 1 to 380,000..	£1	20 %	20 %	20 %	20 %	4⅜ – 4⅝	4⅜ – 4⅝	92/6	..	..	4 3 9
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	£1	6 %	6 %	6 %	6 %	1⅞ – 1⅛	1⅞ – 1⅛	..	..	..	5 19 2
60,000	British Aluminium, Ord., 1 to 40,000	£5	7 %	7 %	7 %	Nil	¾ – 1	¾ – 1	..	..	..	Nil
60,000	Do. do. 7 % Cum. Pref.	£5	7 %	7 %	7 %	3½%	1⅜ – 2⅛	1⅜ – 2⅛	..	..	..	7 15 0
40,100	Do. do. "A" 6 % Cum. Pref.	£5	6 %	6 %	6 %	6 %	3½ – 3⅞	3½ – 3⅞	..	..	..	7 10 11
12,997	Do. do. 4 % Funding Certs.	£5	4 %	4 %	4 %	2 %	2¾ – 3¼	2¾ – 3⅛	..	..	..	5 11 1
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	..	5½%	5½%	5½%	97 – 100	97 – 100	..	..	..	5 10 0
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	8 %	8 %	139 –143	141 –145	142½	140	+2	5 10 4
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	5 %	6 %	121 –125	121 –125	125⅛	123	..	4 16 9
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	108 –111	110 –113	112	110⅞	+2	4 8 6
283,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	£0	4½%	4½%	4½%	4½%	102 –104	102 –104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,300	100	4½%	4½%	4½%	4½%	102 –105	102 –105	103⅜	..	..	4 6 2
188,301	British Electric Traction	£0	2 %	Nil	Nil	Nil	⅜ – 1	⅜ – 1	..	..	..	Nil
161,487	Do. do. 6 % Cum. Pref.	£0	6 %	6 %	8 %	1½%	2⅜ – 3	2⅜ – 3	..	..	..	5 0 0
1,473,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	84 – 87	84 – 87	84⅜	..	..	5 14 11
598,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	60 – 65	60 – 65	..	..	..	7 10 0
100,000	British Insulated and Helsby Cables	£5	8 %	10 %	10 %	10 %	7 – 7¼	7 – 7¼	..	..	..	6 13 4
100,000	Do. do. 6 % Cum. Pref.	£5	6 %	6 %	6 %	6 %	6½ – 6⅝	6¼ – 6⅜	..	..	..	4 10 7
500,000	Do. do. 4½ % 1st Mort. Deb. Red.. ..	100	4½%	4½%	4½%	4½%	103 –106	103 – 106	..	..	..	4 4 11
804,940‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	89 – 94	89 – 94	..	..	..	4 15 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	£5	Nil	Nil	Nil	Nil	⅜ – ⅝	7/16 – 11/16	..	..	+1/16	Nil
1,016,363	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	48 – 52	48 – 52	50½	49½	..	7 13 10
60,000	Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	Nil	⅛ – ¼	⅛ – ¼	..	..	..	Nil
60,000	Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	£1	2½%	Nil	Nil	Nil	0 – ¼	0 – ¼	..	..	..	Nil
300,000	Do. do. Non-cum. 6 % Pref.	£1	6 %	Nil	Nil	Nil	0 – ¼	0 – ¼	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	41 – 46	41 – 46	..	..	..	9 15 8
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	27 – 31	27 – 31	..	..	..	14 10 2
187,610	Calcutta Trams, 1 to 187,610	£5	8 %	8 %	6 %	4½%	4½ – 5	4½ – 5	..	..	..	4 10 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	£5	5 %	5 %	5 %	5 %	4½ – 5	4½ – 5	96/3	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	101 –104	101 –104	..	..	..	4 6 7
35,000	Callender's Cable Construction shares	£5	15 %	15 %	15 %	15 %	10 – 10½	10 – 10½	..	..	..	6 19 4
40,000	Do. do. 5 % Cum. Pref.	£5	5 %	5 %	5 %	5 %	6½ – 6⅝	6½ – 6⅝	..	..	..	4 8 11
900,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105 –107	105 –107	..	..	..	4 4 3
491,222	Cape E. Trams., 1 to 491,222	£1	Nil	Nil	Nil	Nil	1/16 – 1/8	1/16 – 1/8	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	£1	6 %	8 %	12 %	12½%	2⅛ – 2⅜	2⅛ – 2⅜	46/-	..	— 1/16	5 5 3
710,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4 %	–102	105 – 108	..	..	..	3 14 1
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	4 %	3 %	3½%	62 – 65	64 – 66	65	64	..	4 18 6
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 – 87	85 – 87	..	..	+1	4 12 0
554,655	Do. do. Def. do.	Stock	4 %	4 %	2 %	2½%	45 – 47	46 – 48	47	46½	+1	5 4 2
1,480,000	City and South London Railway	Stock	1½%	2½%	3½%	1½%	32 – 33	32 – 33	33	32⅝	..	4 10 0
85,000	Crompton & Co., Nos. 1 to 85,000	£1	2½%	5 %	5 %	Nil	½ – 1	½ – 1	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	90 – 93	90 – 93	..	..	..	5 7 6

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1905.	1906.	1907.	1908.	Closing Quotations Dec. 21st.	Closing Quotations Dec. 28th.	Business done week ended Dec. 28th, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
250,000	Dick, Kerr & Co., 1 to 250,000	1	10 %	10 %	10 %	6 %	1 — 1½	1 — 1½	..	..	..	6 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..	5 4 4
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12⅜— 13⅜	12⅜— 13⅜	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	3	4½%	4½%	2½%	Nil	5/16— 7/16	5/16— 7/16	..	..	..	Nil
17,189	Do. "A" shares, 01—017,189	5	4½%	4½%	2½%	Nil	1 — 1⅛	1 — 1⅛	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	66 — 71	66 — 71	..	..	..	5 12 1
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	81 — 84	81 — 84	..	..	..	5 19 1
112,100	Electric Construction, 1 to 112,100	1	Nil	Nil	Nil	Nil	7/16— 9/16	7/16— 9/16	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890..	1	7 %	7 %	7 %	7 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	10 4 0
75,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
2 0,000	Do. do 4 % Mort Deb...	Stock	4 %	4 %	4 %	4 %	83 — 87	83 — 87	..	..	..	4 12 0
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	3½%	Nil	⅜ — ½	⅜ — ½	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref	10	7 %	7 %	7 %	..	10½— 10¾	10½— 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103½	..	..	+ ½	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15%	15 %	15%	15 %	12 — 12⅝	12 — 12⅝	..	..	..	5 17 8
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 3 9
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	104 —106	104 —106	..	..	..	4 4 11
50,000	India-Rubber, Gutta-percha & Telegraph Works..	10	10%	10 %	10 %	10 %	15⅝ — 16⅝	15⅝ — 16⅞	16 3/16	16 1/16	..	6 1 3
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	Nil	½%	Nil	⅜ — ½	⅜ — ½	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..	10 0 0
600,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	3 %	Nil	1½ — 2½	1½ — 2½	..	..	..	Nil
399,980	Do. do. 60,008 to 100,000	10	3 %	3 %	3 %	Nil	1½ — 2½	1½ — 2½	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	3½%	2 — 2½	1⅞ — 2⅛	40/-	..	— ½	16 13 4
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	61 — 64	59 — 64	59⅞	..	—1	6 5 0
5,782,062	Metropolitan Consolidated	100	2½%	1 %	½%	½%	39½ — 40	39⅜ — 40½	40	39⅞	+ ½	1 4 4
2,640,914	Do. Surplus Lands	100	2½%	2½%	2½%	2½%	66 — 68	66 — 68	67½	..	..	4 0 11
8,235,000	Do. District	100	Nil	Nil	Nil	Nil	17⅞ — 18⅛	18⅛ — 18⅜	18⅝	18⅛	+ ½	Nil
891,837	Metropolitan Electric Trams., Ord.	1	..	..	..	44%	⅛ — ¼	⅛ — ¼	..	..	..	6 10 11
814,016	Do. do. Defd.	1	Nil	Nil	Nil	Nil	1/16— 3/16	1/16— 3/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16— 3/16	1/16— 3/16	..	..	..	6 8 1
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
$10,828,200	Mexico Trams Co., Common Stock	..	..	..	..	..	123 —125	123 —125	124	..	..	..
$7,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	..	5 %	91½ — 93½	91½ — 93½	92⅝	..	..	5 6 11
245,500	Potteries Electric Traction	1	4 %	4 %	4 %	Nil	1/16— 3/16	1/16— 3/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16— 3/16	1/16— 3/16	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	84 — 87	84 — 87	..	..	..	5 3 6
97,850	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	15 %	34½ — 36	34½ — 36	35⅝	35½	..	5 3 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 18 1
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	5 %	100½ —101½	100 —101	101⅜	100½	—1	4 19 0
2,800,000	Do. do. 4½% Bonds	..	..	..	..	4½%	88 — 89	88 — 90	..	..	+ ½	5 1 2
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	34 — 36	34 — 36	..	..	..	..
66,666	Willans & Robinson, 1 to 50,000 & 80,001 to 116,666	1	Nil	Nil	10 %	5 %	⅛ — ¼	⅛ — ¼	..	..	..	..
66,666	Do. 6 % C.P., 80,001 to 80,000 & 125,001 to 141,666	5	Nil	..	6 %	6 %	1½ — 2½	1½ — 2½	..	..	..	2 8 4
245,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	72 — 77	72 — 77	..	..	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5⅛%	5⅛%	5⅛%	5⅛%	4½ — 4¾	4½ — 4¾	..	..	..	5 15 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	91 — 94	91 — 94	..	..	..	4 18 9
80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10%	10 %	10 %	7 — 7⅛	7 — 7⅛	7 1/16	7 1/32	..	6 13 4
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 7⅛	7 — 7⅛	..	..	..	4 13 4
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	98 —101	..	..	—1	3 19 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3⅜ — 4⅛	3⅜ — 4⅛	..	..	+ ⅛	5 14 3
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¾ — 4	3¾ — 4	..	..	..	5 0 0
445,786	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
49,486	Chelsea Electricity Supply, Ord.	5	6 %	4½%	4½%	4½%	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..	6 4 2
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	102½	..	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	10½ — 10⅞	10½ — 10⅞	..	..	..	5 11 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅞ — 12⅛	11⅞ — 12⅛	..	..	..	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
300,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
50,000	County of Durham Electrical Power, Ord.	5	4 %	4 %	2 %	..	1⅝ — 2	1⅝ — 2	..	..	..	5 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅜ — 3⅜	2⅜ — 3⅜	..	..	..	7 8 2
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	5 %	93½ — 95½	93½ — 95½	..	..	..	5 4 9
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅛ — 8	7⅛ — 8	..	..	..	6 5 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜ — 11⅛	10⅜ — 11⅛	..	..	..	5 7 10
400,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	4 %	Nil	Nil	Nil	3/16— 5/16	3/16— 5/16	..	..	..	Nil
10,000	Do. do. 6 % Cum. Pref.	5	6 %	3 %	Nil	Nil	⅜ — ½	⅜ — ½	..	..	+ ⅛	Nil
439,600	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	57 — 60	57 — 60	..	..	..	7 10 0
$1,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	..	5 %	91 — 94	91 — 94	..	..	..	5 6 5
10,000	Fo kestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	9 %	9 %	8½%	8½%	6⅞ — 7⅛	6⅞ — 7⅛	7⅛	..	..	5 13 4
$1,876,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	..	5 %	101½ —103½	101½ —103½	..	..	..	4 16 7
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	10 %	8 %	7 — 7⅛	7 — 7⅛	..	..	..	5 4 1
90,000	Do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	4 %	2½%	3 %	1⅝ — 2	1⅞ — 2⅛	35/7½	..	+ ⅛	4 4 3
70,000	Do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 17 1
262,855	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4½%	4½%	4 %	92 — 95	92 — 95	..	..	..	4 4 8
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	8 %	8½%	5 %	3⅞ — 4⅛	4 — 4⅛	85/-	..	+ ⅛	5 11 1
75,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5	4⅜ — 5	..	..	..	4 10 0
285,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	83½ — 86½	83½ — 86½	..	..	..	4 0 11
$1,000,000	Mexican Electric Light Co.. 6% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	81 — 83	81 — 83	82½	..	..	6 0 6
$3,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	3½%	68 — 70	68 — 70	69½	68⅜	..	5 0 0
$3,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	7 %	101 —105	100 —104	100	..	—1	6 14 7
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	..	5 %	85 — 87	86½ — 87⅛	87⅛	85⅞	+ ⅛	5 14 3
950,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
180,491	Newcastle-on-Tyne, 1 to 187,500	5	3 %	3 %	3 %	2½%	3⅜ — 4¼	3⅜ — 4¼	..	..	..	2 16 9
187,500	Do. 5 % Pref., 1 to 187,500	5	5 %	5 %	5 %	5 %	3⅞ — 4¼	3⅞ — 4¼	..	..	..	5 17 8
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	..	98 —100	93 — 100	..	..	..	..
16,853	Notting Hill Electric Lighting	10	7½%	7½%	7½%	7 %	12½— 13½	12½— 13½	..	..	..	5 6 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6 — 6⅜	6 — 6⅜	..	..	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
119,894	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	2½%	6 %	8 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	4 18 6
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1 3/32— 1 5/32	1 3/32— 1 5/32	..	..	..	5 19 0
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	103 —106	103 —106	..	..	..	4 14 4
40,000	St. James' and Pall Mall Electric Light, Ord.	5	12½%	10 %	10 %	10 %	8¾ — 9	8¾ — 9	8 1/16	8⅜	..	6 7 0
90,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 7⅛	7 — 7⅛	..	..	..	5 11 1
150,000	Do. do. 3½ % Deb. Stock Red.	100	3 %	3½%	3½%	3½%	84 — 88	84 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	Nil	Nil	Nil	1½ — 2	1½ — 2	..	..	..	Nil
85,000	South London Electric Supply, Ord.	4	4 %	8 %	4 %	5 %	2⅝ — 3	2⅝ — 3⅛	..	..	+ ⅛	6 9 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	2½%	1/16— 3/16	1/16— 3/16	..	..	..	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	5 17 11
294,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	⅜ — ½	⅜ — ½	..	..	..	25 6 8
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	14 5 4
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	74⅜ — 78⅜	74⅜ — 78⅜	..	..	..	5 14 8
868,000	Victoria Falls Power Co., Pref. Nos. 1 to 868,000	1	..	..	..	5 %	3/16— 5/16	3/16— 5/16	..	..	..	5 6 8
100,000	Westminster Electric Supply, Ord.	5	12 %	12 %	10 %	10 %	8½ — 9	8⅝ — 9⅛	..	..	+ ⅛	5 9 7
81,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	5 %	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 0 0

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent., December 9th, 1909.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING NOVEMBER, 1909.

The November returns of electrical business were considerably ahead, in all three sections, of those of the previous months—the imports especially, their total having only once been exceeded during the past five years.

The exports for the month were valued at £309,607, this figure including £49,170 of telegraphic material, and being comparable with a total of £265,523 recorded in October.

A year ago, however, the November total reached £336,100, due to an abnormal export of telegraphic plant.

The imports total of £191,504 compares with £164,246 in October and £144,163 in November, 1908, while the re-exports were valued at £16,336, or somewhat above the average.

The improved export total can be attributed mainly to better business in the electrical machinery, tel-phone and telegraph sections, for it will be noted that the cable exports were some £18,000 less than in the previous month.

The individual items of the import table, with one exception, show an increase over the previous month's figures; the exception, however, electric lamps, amounted to over £50,000 in value, and is actually the most prominent section in the returns.

The Argentine, Japan, India and Canada were our best customers, while Germany, as usual, was the most prominent importer into this country.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric lamps and parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	89	1,891	48	186	282	4,064	38	80	...	3	161	6,842
Germany	97	514	24	57	51	2,141	...	8	...	41	46	2,979
Netherlands and Java	238	879	20	159	14	502	...	...	...	...	53	1,865
Belgium	82	483	33	17	922	933	30	50	...	536	118	3,209
France and Switzerland	22	28	134	478	171	2,053	...	...	...	34	70	2,990
Portugal, Madeira and Portuguese Africa ...	90	151	94	172	48	1,739	14	233	...	179	59	2,779
Spain and Canary Isles	106	...	113	210	...	2,152	...	39	...	1,061	...	3,691
Italy and Austria-Hungary	92	...	13	...	801	3,841	...	...	...	112	598	5,457
Greece, Bulgaria, Roumania and Turkey ...	401	...	92	184	...	180	...	181	...	10	103	1,051
Channel Isles, Gibraltar and Malta	40	...	...	23	12	240	1,300	48	...	...	29	1,692
U.S.A. and Cuba	59	...	...	29	180	665	...	...	468	13	4,713	6,127
Canada and Newfoundland	328	1,165	1,416	350	1,981	1,415	...	101	...	...	17,991	24,747
Bahamas, British West Indies and British Guiana	16	11	30	114	...	79	...	5	...	32	6	293
Mexico, Colombia, Bolivia and Panama ..	...	148	...	472	...	752	...	25	...	127	1,172	2 696
Peru and Uruguay	87	61	42	63	25	6,067	...	...	38	...	...	6,383
Chile	223	341	38	544	15	1,525	2,315	63	12	88	10	5,174
Brazil	404	237	322	223	62	6,731	6,147	874	...	...	1,436	16,436
Argentine	1,422	6,452	105	856	409	20,517	352	2,743	99	16,211	4,061	53,227
Egypt	166	12	221	16	3	99	3	298	...	536	57	1,411
British West Africa, Ascension and St. Helena...	180	177	19	70	43	158	1,279	5	12	57	29	1,989
Cape of Good Hope	1,222	401	374	839	67	457	...	1,067	42	73	332	4,874
Natal	1,440	8 876	238	389	205	2,839	25	277	11	321	...	14 621
Rhodesia, O.R.C. and Transvaal	1,740	9,361	63	891	2	6,742	316	266	16	130	15	19,542
Zanzibar, Brit. East Africa, Mauritius & Aden	134	185	52	98	29	232	3	10	...	170	72	985
China and Siam	851	608	1,458	252	...	2,449	90	30	...	2 021	89	7,778
Japan	85	1,470	330	102	1,391	14,104	590	2,827	...	1,213	15,053	37,165
India	770	8,154	2,254	1,524	1,093	11,804	3,907	5,035	45	423	749	35,758
Ceylon	60	87	29	223	654	65	64	17	...	305	46	1,550
Straits Settlements, Fed. Malay States, British North Borneo and Sarawak ..	260	1 280	87	111	38	172	23	51	...	17	51	2,090
Hong Kong	220	338	53	305	...	891	24	29	21	11	...	1,892
West Australia	271	346	6	838	...	656	283	27	...	37	845	3,309
South Australia...	320	926	27	253	19	883	7	...	29	5	...	2,469
Victoria	1,100	2,572	25	474	11	1,041	...	166	...	4,864	44	10,297
New South Wales	2,819	1,015	289	505	486	2,664	1,667	275	...	224	190	10,134
Queensland	15	263	...	101	21	83	196	17	...	...	...	696
Tasmania	...	...	...	85	28	21	...	...	...	52	39	225
New Zealand	471	1,261	137	798	112	405	983	52	13	29	933	5,194
Total, £	15,920	49,698	8,186	12,011	9,175	101,361	19,546	14,799	806	8,935	49,170	309,607

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Norway, Sweden and Denmark	20	6	...	208	26	1,476	...	678	...	3,458	5,872
Germany	315	14,465	1,694	41,358	1,800	29,405	206	1,661	11,976	19,560	122,440
Holland	48	...	...	2,636	10	...	19	...	44	...	2,757
Belgium	665	592	362	76	232	4,335	45	283	373	2,769	9,732
France	473	40	1,265	2,539	993	25	...	1,500	2,967	3,421	13,223
Switzerland	5,911	...	29	10	98	...	...	8	20	194	6,270
Italy	52	1,230	...	...	...	23	...	...	...	1,606	2,911
Austria-Hungary	...	734	...	541	4	168	...	...	1,477	269	3,193
United States	2,457	1,213	1,148	2,791	...	13,078	3,469	137	54	759	25,106
Total, £	9,941	18,280	4,498	50,159	3,163	48,510	3,739	4,267	16,911	32,036	191,504

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	
Various countries, mainly as above	2,903	572	...	2,668	...	2,633	...	262	854	6,444	...

TOTAL EXPORTS: £309,607. TOTAL RE-EXPORTS: £16,336. TOTAL IMPORTS: £191,504.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

THE LOADING OF TELEPHONE CABLE CIRCUITS.*

By A. W. MARTIN.

(*Continued from page* 995.)

PART II.

In this section of the paper, it is proposed to deal with the application of the formulæ for α and β to practical cases, and the simplification of the expressions where possible. It will be convenient to divide telephone circuits, so far as the lines themselves are concerned, into two classes: first, those in which the inductance is merely that between the ordinary wires forming the loop, which circuits are said to be *unloaded*, and, second, those in which the inductance has been increased by distributing iron along the whole length of the conductors, or in which inductance coils have been inserted at regular intervals. Circuits of this second class are said to be *loaded*; and coils used to increase the inductance are known as *loading coils*.

Before proceeding further, it is necessary to emphasise that any sound made in normal speech is complex; inasmuch as it may be composed of a number of superposed vibrations or waves, some having periodicities as low, or lower, than 100 per second, and others as high, or higher, than 2,000 per second. These vibrations or waves should be reproduced in their proper order or proportion in a telephone circuit if good speech transmission is to be obtained. Supposing all the sound waves at the sending end to have been properly converted into periodic currents of electricity, then, if all the variations of current strength reached the receiving end of the circuit in their proper order and proportion, the reproduction of the quality of the original speech—or articulation, as it is called—would be perfect. An inspection of the formulæ for both α and β will show that they each become greater with the frequency, which means that waves of different frequencies are not transmitted with the same velocity, nor are they subject to the same attenuation. If, however, $K R$ be made equal to $S L$, then the expression for α reduces to—

$$\alpha = p\sqrt{K L} = 2\pi f\sqrt{K L}.$$

Now the velocity, v, $= \dfrac{2\pi f}{\alpha}$

$$= \frac{2\pi f}{2\pi f\sqrt{K L}} = \frac{1}{\sqrt{K L}},$$

so that, if K and L were independent of frequency, all waves would travel with the same velocity. Again, on the same assumption, namely, that $K R = S L$, the equation for β reduces to—

$$\beta = \sqrt{R S},$$

which is apparently independent of the frequency; and, if this be the case, all waves are proportionately attenuated. When these conditions obtain, the circuit is said to be *distortionless*. In the first place, no ordinary substance used as a dielectric, other perhaps than air, is known to remain fairly constant in specific inductive capacity and leakance for all telephonic frequencies; while, if there be any iron in the neighbourhood of the conductor, it is improbable—if not impossible—that R and L will remain constant for all frequencies; so that the distortionless circuit, so far as the telephone engineer is concerned, is a thing at present impossible of attainment. Even supposing it were easy to attain, say, by increasing L or reducing S and taking into consideration the absolutely lowest present known values for K and R, in any case of practical telephony, it would be found that the resulting attenuation would be so great, although the articulation might be perfect, that the volume or loudness of speech obtained would be too small on a lengthy line to be of any commercial use whatever.

As the attenuation is different for different frequencies, it is necessary to state in every case what periodicity has been assumed. It is usual to take an average frequency for telephonic currents, and to regard all the elementary waves making up a complex wave as being attenuated in the same way as the average. What this mean value is, is a matter of some debate. Generally, in this country, it is taken as 750 periods per second; but some place it as high as 800. For attenuation calculations the former will be assumed unless otherwise stated. Later on, it is explained why, when velocity is being considered, 2,000 is taken as the periodicity.

Unloaded Lines.—Although underground circuits, and the like, are primarily being considered, it may be mentioned in passing that in calculating the attenuation of an ordinary overhead line the full formula for β should be used, as none of the factors are negligible. In underground or submarine cable circuits, however, the insulation resistance between wire and wire is of a high order; rarely being as low as 5 megohms per mile, and often as high as 2,000. Generally, then, S, the leakance, is not greater than 0·0000002 mhos; so that, without producing any appreciable error in the results, S may be neglected. If this be done—

$$\alpha = \sqrt{\tfrac{1}{2} p K (\sqrt{R^2 + p^2 L^2} + p L)},$$

$$\beta = \sqrt{\tfrac{1}{2} p K (\sqrt{R^2 + p^2 L^2} - p L)}.$$

These formulæ in cases where S is negligible are applicable to all unloaded subterranean and submarine telephone circuits possessing normal resistance, inductance and electrostatic capacity. A further simplification is possible in special cases, such as when the resistance of the circuit is high compared with the product $p L$. The inductance of any loop in an underground paper cable, unloaded, may be taken as 0·001 henry per mile; consequently, if $p = 2\pi \times 750$, $p L = 4{\cdot}7$ approximately. In the case of 10 or 20 lb. per mile copper conductor loops, where the resistance per mile of loop is 176 and 88 ohms respectively, it may be taken that $\sqrt{R^2 + p^2 L^2} = R$ nearly, and that $\sqrt{R - p L} = \sqrt{R}$ nearly, with the result that—

$$\beta = \sqrt{\tfrac{1}{2} p K R}.$$

It should, however, be understood that the result is only approximately correct, say, to within 5 per cent.

Loaded Lines.—In the case of circuits in which the inductance per mile of loop has been greatly increased *by the insertion of loading coils*, a considerable simplification of the formulæ for α and β is possible. It should be noted that the following consideration does not apply, at present, to cases where the inductance is increased by winding iron wire over the conductors. The reasons for making this reservation are given in Part III.

In a properly loaded circuit the product $p L$ is much greater than R; and in any normal underground or submarine circuit the product $p K$ is much greater than S.

Take, first, the expression—

$$\alpha = \sqrt{\tfrac{1}{2}\left[\sqrt{(R^2 + p^2 L^2)(S^2 + p^2 K^2)} - (R S - p^2 L K)\right]}$$

and extract from it $\sqrt{R^2 + p^2 L^2}$.

$$\sqrt{R^2 + p^2 L^2} = p L \left(1 + \frac{R^2}{p^2 L^2}\right)^{\frac{1}{2}},$$

and expanding this by the binomial theorem—

$$\sqrt{R^2 + p^2 L^2} = p L \left(1 + \frac{R^2}{2 p^2 L^2} - \frac{R^4}{8 p^4 L^4} \ldots \&c.\right);$$

all terms involving higher powers than the square may be ignored as being too small to make any practical difference in the result, so that—

$$\sqrt{R^2 + p^2 L^2} = p L \left(1 + \frac{R^2}{2 p^2 L^2}\right) \text{ nearly.}$$

Similarly, it may be shown that—

$$\sqrt{S^2 + p^2 K^2} = p K \left(1 + \frac{S^2}{2 p^2 K^2}\right) \text{ nearly.}$$

The term $\sqrt{(R^2 + p^2 L^2)(S^2 + p^2 K^2)}$

then becomes $\left[p L \left(1 + \dfrac{R^2}{2 p^2 L^2}\right) \cdot p K \left(1 + \dfrac{S^2}{2 p^2 K^2}\right)\right]$

or $p^2 K L \left(1 + \dfrac{R^2}{2 p^2 L^2} + \dfrac{S^2}{2 p^2 K^2} + \dfrac{S^2 R^2}{4 p^4 L^2 K^2}\right)$.

* A paper read before the Institution of Post Office Electrical Engineers on January 11th and February 8th, 1909.

The last term within the bracket is so small a quantity as to be negligible, and by multiplying out the expression becomes—

$$p^2 \text{K L} + \frac{p^2 \text{R}^2 \text{K L}}{2\, p^2 \text{L}^2} + \frac{p^2 \text{S}^2 \text{K L}}{2\, p^2 \text{K}^2}$$

$$= p^2 \text{K L} + \frac{\text{R}^2 \text{K}}{2\,\text{L}} + \frac{\text{S}^2 \text{L}}{2\,\text{K}}.$$

The complete expression for α then becomes—

$$\alpha = \sqrt{\tfrac{1}{2}\left[p^2 \text{K L} + \frac{\text{R}^2 \text{K}}{2\,\text{L}} + \frac{\text{S}^2 \text{L}}{2\,\text{K}} - \text{R S} + p^2 \text{L K}\right]}, \quad (13)$$

$$= \sqrt{p^2 \text{K L} + \frac{\text{R}^2 \text{K}}{4\,\text{L}} + \frac{\text{S}^2 \text{L}}{4\,\text{K}} - \frac{\text{R S}}{2}}$$

$$= p\sqrt{\text{K L}\left(1 + \frac{\text{R}^2}{4\,p^2 \text{L}^2} + \frac{\text{S}^2}{4\,p^2 \text{K}^2} - \frac{\text{R S}}{2\,p^2 \text{K L}}\right)}.$$

$$= p\sqrt{\text{K L}\left[1 + \left(\frac{\text{R}}{2\,p\,\text{L}} - \frac{\text{S}}{2\,p\,\text{K}}\right)^2\right]}.$$

If, as stated, p L be great compared with R, and p K be great compared with S, then—

$$\frac{\text{R}}{2\,p\,\text{L}} - \frac{\text{S}}{2\,p\,\text{K}} \text{ is negligible,}$$

and $$\alpha = p\sqrt{\text{K L}},$$

which result is *not* to be compared with the one of similar form given previously, because in this case it is *not* assumed that K R = S L.

Take next the expression for β, and notice that it only differs from that for α in that the last term under the principal root sign is positive. Making the same assumption as before in connection with the magnitudes of p L and p K, the complete expression for β is (from equation 13)—

$$\beta = \sqrt{\tfrac{1}{2}\left[p^2 \text{K L} + \frac{\text{R}^2 \text{K}}{2\,\text{L}} + \frac{\text{S}^2 \text{L}}{2\,\text{K}} + \text{RS} - p^2 \text{L K}\right]}, \quad (14)$$

$$= \sqrt{\frac{\text{R}^2 \text{K}}{4\,\text{L}} + \frac{\text{S}^2 \text{L}}{4\,\text{K}} + \frac{\text{R S}}{2}}$$

$$= \sqrt{\frac{\text{R}^2 \text{K}}{4\,\text{L}}\left(1 + \frac{\text{S}^2 \text{L}^2}{\text{K}^2 \text{R}^2} + \frac{2\,\text{S L}}{\text{K R}}\right)}$$

$$= \sqrt{\frac{\text{R}^2 \text{K}}{4\,\text{L}}\left(1 + \frac{\text{S L}}{\text{K R}}\right)^2}$$

$$= \frac{\text{R}}{2}\sqrt{\frac{\text{K}}{\text{L}}}\left(1 + \frac{\text{S L}}{\text{K R}}\right)$$

$$= \left(\frac{\text{R}}{2} + \frac{\text{S L}}{2\,\text{K}}\right)\sqrt{\frac{\text{K}}{\text{L}}}$$

$$= \frac{\text{R} + \frac{\text{S}}{\text{K}}\text{L}}{2}\sqrt{\frac{\text{K}}{\text{L}}}.$$

This formula gives the attenuation constant for any loaded circuit provided p L be great compared with R, and p K be great with respect to S, as is usually the case.

Methods of determining the values of R and L at different frequencies are fairly well known, and for the particular periodicity considered, we may, therefore, insert the measured values in the above formula. This, however, is not the case with S and K. Very little information is available respecting the variation of electrostatic capacity and insulation resistance with frequency. Further experimental investigation appears to be necessary on the following points :—

(*a*) What is the periodicity which may be taken as the mean of a speech wave ?

(*b*) Is this mean frequency the same for all types of circuit, and if not, how does it vary ?

(*c*) How do electrostatic capacity and leakance vary with frequency in paper and gutta-percha-covered conductors such as are commonly used in practice ?

In this paper it is not intended to discuss these matters, owing to lack of information of a definite character. There is, however, one assumption which may be made with some degree of safety : namely, that at any particular frequency the ratio of S to K will be constant.

Let $$\frac{\text{S}}{\text{K}} = n,$$

then $$\beta = \frac{\text{R} + n\,\text{L}}{2}\sqrt{\frac{\text{K}}{\text{L}}}.$$

In the present incomplete state of knowledge as to the variation of K with frequency and of what the mean frequency in any particular circuit is, the only thing to be done is to take K as being the same at all periodicities, and by associating a large number of practical results to fix a value to the constant n, which most nearly fits the observed results. This, as will be seen later on, has been done, with the results that when the loading coils used have non-magnetic cores, and have no magnetic material near them, $n = 50$; and, when the loading coils have cores of magnetic material in the form of a closed magnetic circuit, then, $n = 80$, give results sufficiently near the truth for present practice in the matter of estimating what improvement will be effected by loading a particular circuit. It must, however, be noted that these figures are based upon the observations made with the coils described in Part III ; where it is mentioned that the effective resistance of so-called "iron-core coils" is much less than that of the "air-core coils" for a given inductance. The difference in effective resistance of the two types of coil for the same inductance may explain the reason for the different value of the constant n required to make the observed and calculated results agree. These matters require further thought and investigation, but until such investigation has been made, it may be accepted with confidence that—

(*a*) Where loading coils *without* magnetic coils are used,

$$\beta = \frac{\text{R} + 50\,\text{L}}{2}\sqrt{\frac{\text{K}}{\text{L}}}.$$

(*b*) Where loading coils with magnetic cores (such as are mentioned hereafter) are employed,

$$\beta = \frac{\text{R} + 80\,\text{L}}{2}\sqrt{\frac{\text{K}}{\text{L}}}.$$

Anyone who studies these formulæ, or, indeed, who scans the practical results given in Part III, will at once appreciate the necessity for keeping the resistance R as low as possible for any given increase in the value of the inductance L.

It is very lamentable that little attention appears to have been paid to Mr. Oliver Heaviside's repeated indications that inductance would be beneficial in a telephone loop. Some eminent scientists appear to have recognised the importance of the matter, amongst them being Prof. S. P. Thompson, but no definite information as to the manner in which the inductance might be efficiently inserted appears to have been given until the subject was investigated mathematically and experimentally in America by Prof. M. I. Pupin, whose papers are worthy of the most serious consideration ; they are "Transactions of the American Institute of Electrical Engineers," (*a*) March 22nd, 1899 ; "Propagation of Long Electrical Waves," (*b*) May 19th, 1900 ; "Wave Transmission over Non-Uniform Cables and Long-Distance Air Lines."

Other valuable work has also been done by Dr. G. A. Campbell, see *Phil. Mag.*, 1903, Vol. 5, page 313, "On Loaded Lines in Telephonic Transmission."

Lagrange in his "Mecanique Analytique," Sec. partie, Sec. VI, Lord Rayleigh in his "Theory of Sound," Vol. I, pages 233 and 234, Prof. Routh in his "Advanced Rigid Dynamics," page 260, and many others have investigated the propagation of waves along uniformly loaded strings. They show, in effect, that if a long, thin stretched string be taken and loaded by small weights at equal distances along its length, it will vibrate practically as though uniformly loaded if there be not less than π loads per wave length ; or, that the string will transmit waves when the length of each wave is such as to include π loads. Of course, the closer the loads, the shorter will be the wave length which the string will be able to transmit.

Prof. Pupin and Dr. Campbell each seem to have recognised an analogy between the behaviour of a loaded string under tension, fig. 6, and that of an electric circuit, fig. 7,

where the inductance coils inserted at regular intervals take the place of the loads on the string. The papers of the able investigators referred to will throw all necessary light upon this matter. Because the inductances inserted in an electric

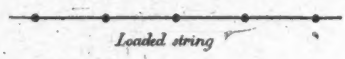

Fig. 6.

circuit limit the wave length which can be transmitted, in the same way as the loads upon a string limit the wave lengths which it will transmit, they are regarded as loads and the coils are called *loading coils*.

Working upon this analogy between the transmission of waves along a loaded string under tension, and a loaded electric circuit respectively, it will be accepted that there must be at least π coils per wave length in the circuit. To obtain sufficiently clear speech for practical purposes, it is essential that waves having a periodicity of 2,000 per

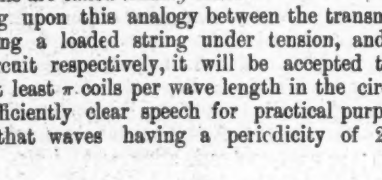

Fig. 7.

second should be transmitted; there must, therefore, be π coils per wave length at this high frequency. This fact may be made use of in establishing a simple rule for the minimum distance apart for the loading coils selected to serve any circuit. Thus—

$$\text{Wave length} = \lambda = \frac{2\pi}{a}.$$

If D be the distance in miles between the coils, then—

$$D = \frac{\lambda}{\pi} = \frac{2}{a}.$$

But in a loaded circuit it has been shown that—

$$a = p\sqrt{K L} = 2\pi f\sqrt{K L}$$

where f is the periodicity per second.

$$\therefore D = \frac{2}{2\pi f\sqrt{K L}} = \frac{1}{\pi f\sqrt{K L}}.$$

and

$$D^2 = \frac{1}{\pi^2 f^2 K L}$$

Now let K_1 and L_1 be the electrostatic capacity in *microfarads* and the inductance in *millihenrys* respectively per mile of loop. Then—

$$D^2 = \frac{10^9}{\pi^2 f^2 K_1 L_1}.$$

But the inductance between the actual wires of any telephone loop in practice is so small as to be negligible compared with that added in loading the circuit; so that L_1 may be taken as the inductance per mile due to the coils. If, therefore, L_2 be the inductance in *millihenrys* of each coil used—

$$L_1 = \frac{L_2}{D},$$

and by substituting this in the above equation for D^2—

$$D = \frac{10^9}{\pi^2 f^2 K_1 L_2},$$

or

$$D K_1 L_2 = \frac{10^9}{\pi^2 f^2}.$$

Taking $f = 2{,}000$ periods per second—

$$D K_1 L_2 = 25{\cdot}3.$$

This result represents the worst permissible condition—namely, that in which there are just π coils per wave at 2,000 periodicity. It is better in practice to allow some margin, so that commonly πf is taken as equalling 7,000, which, according to the view taken, allows more than π coils per wave at 2,000 periods, or allows shorter waves to be transmitted at π coils per wave-length. If $\pi f = 7{,}000$, then—

$$D K_1 L_2 = 20{\cdot}4.$$

The general rule is, therefore, that the product of the distance apart of the coils in miles, the electrostatic capacity per mile in microfarads, and the inductance per coil in millihenrys should not be greater than 25·3, and need not be less than 20·4.

(*To be continued.*)

CONCILIATION.

There has been so much friction between employers and employés upon municipal tramways, that we welcome any scheme which has for its aim the nipping in the bud of labour disputes. The way has been made clear by many earlier workers, and the production of a mutually acceptable set of general principles and rules to govern procedure has been simplified by the existence of precedents. Nevertheless, the formulation of the "scheme for conciliation and arbitration, as agreed between the Board of Trade, the L.C.C., and the employés of the Council in the Tramways Department, for the settlement of questions affecting the employés in the Tramway Department," must have involved a great deal of hard work which, often enough, no doubt, became tedious and unpleasant as well. The three bodies concerned are to be congratulated upon the technical results of their labours, and it is to be hoped that the conciliation boards will sweeten continually the relations between master and man, and will prevent effectually the recurrence of those unseemly disputes, which, from time to time, have disturbed the public peace.

We, like all who wish earnestly to see the nation prosperous, have viewed with growing apprehension the creation and prolific growth of an army of municipal employés, whose "power for selfishness" increases just twice as fast as its numbers. To such a politically powerful body a strike is a tempting weapon, and "pressure" would develop from the spasmodic to the usual.

We do not suppose that the erection of any number of Conciliation Boards will put an end to the illegitimate use of political pressure for narrow domestic purposes; but these Boards should do something at least to suppress that type of man whom we may call, in imitation of some of our correspondents, the super-growler, or, in better known terms, the professional agitator and the rank Socialist.

We are especially relieved and pleased to see that questions relating to discipline and management are exempted from the jurisdiction of the board. Object lessons have been given to the country during the last few years sufficient to show the more than folly of buying a dog and doing the barking oneself, and the general ridicule of this principle when it is displayed should prevent its introduction into any conciliation scheme which may be drawn up in the future.

The L.C.C. scheme is so important, in that it is the first of its kind applied to tramways, that we have reprinted it below as it appeared in the Agenda of the Council on November 2nd, 1909. Its clauses will repay careful study, and may give rise to considerable criticism, but that will not be surprising under the circumstances. For ourselves, we are not inclined to subject the scheme to any detailed criticism, but we cannot refrain from saying that a second and a third perusal have not sufficed to remove our first impression that the keynote of confidence which we ought to hear is missing. The very first clause under "Procedure" emphasises this:—Each side of a Conciliation Board to select its own chairman. Then in Clause 3 there is provision for appointing two secretaries in case the two sides of the Board cannot agree to any one member of either side. Clause 4 provides that each side of a Board is to vote separately.

These and other clauses indicate rather that the Board is to be formed out of two sets of irreconcilables than

from one general body of men whose sole object is to take evidence upon all aspects of a proposition, and to arrive at their decision upon a basis of moral and commercial justice and equity.

It seems to us, too, that the Board is to be put into an invidious position by the reference of any resolutions involving a reduction of wages to the general body of employés, and we should like to know by what logical process it was determined that a representative board could be trusted to make equitable decisions upon all but one subject.

Upon the whole the scheme has our heartiest approval, and we trust that in due course all the larger towns will adopt something similar.

The L.C.C. scheme is to be given a fair trial for three years as a minimum, unless both sides find it unworkable before the end of that time, and we predict that the general public will feel the benefit of the arrangement indirectly in many ways, because the recent state of uncertainty must have been reflected to some extent in the work of the whole staff, and of the Highways Committee.

General Principles.

1. Conciliation boards to be formed to deal with questions referred to them either by the Council or its employés, affecting any class of employés to which the scheme applies, which cannot be be mutually settled through the usual channels. The questions that may be thus dealt with are:—
   (1) Differences as to rates of wages;
   (2) Differences as to hours of labour;
   (3) Differences relating to general conditions of labour (not being questions of discipline or management).

2. The various grades of the employés of the Council who are covered by the scheme, to be grouped for this purpose in a suitable number of sections, and the area served by the Council to be divided, if necessary, into a number of suitable districts.

3. The employés belonging to each section so grouped, to choose from among themselves one or more representatives, these representatives to form the employés' side of a sectional board to meet representatives of the Council to deal with questions of the nature defined in Clause 1 affecting grades of employés within that section.

4. The term of office of a conciliation board to be three years. Casual vacancies through death, resignation, or loss of qualification to be filled by a special election.

5. Elections, subsequent to the one which has been conducted by the Board of Trade, to be regulated by the central conciliation board.

6. Employés under 21 years of age will not be eligible as representatives on any board, nor entitled to nominate candidates, nor to vote in any election.

7. All questions referred to the conciliation boards to be first submitted to the appropriate sectional board. Where a sectional board fails to arrive at a settlement, the question to be referred on the motion of either side to the central conciliation board.

8. The Council may appoint representatives equal in number to the representatives of the employés on any board, but not more than two representatives on any sectional board shall be officials.

The central board shall consist of six representatives of the Council and six representatives of the employés. Not more than two of the representatives of the Council on the central board shall be officials of the Council.

9. In the event of the central conciliation board being unable to arrive at an agreement, the subject of difference to be referred to arbitration. The reference shall be to a single arbitrator appointed by agreement between the two sides of the board, or, in default of agreement, to be appointed by the Board of Trade. The decision of the arbitratar shall be binding on all parties.

10. No change involving a reduction in wages or an increase in hours of labour, affecting any class of employés to which this scheme applies, shall be brought into operation until it has been considered and decided upon in accordance with this scheme.

Procedure.

1. Each side of a conciliation board to select its own chairman, and each side may from time to time vary such chairman.

2. Every board to meet for business as required at the request of either side, and all business ripe for discussion shall be disposed of at such meeting or an adjournment thereof. A fortnight's notice to be given of all meetings. Any meeting may be adjourned, but no board to be required to meet for new business oftener than once in two months, except that in the case of the central board, where this would involve an interval of more than one month after the failure of a sectional board to agree upon any matter submitted thereto, the central board shall meet to deal with such business as soon as convenient. No meetings shall be called during the Easter, Whitsun, Summer or Christmas recesses of the Council.

3. A secretary shall be appointed by agreement between the two sides of the central board. Failing agreement, each side to appoint a secretary from among the salaried or wages employés of the Council. The secretary or secretaries so appointed shall act for the sectional as well as for the central boards. All meetings of the sectional or central boards to be convened by the secretary or secretaries. The agenda to be circulated with the notices calling the meetings, and no question not on the agenda to be brought up except with the consent of both sides.

4. Each side of a board to vote separately by a majority of the members constituting the side, and all decisions to be arrived at by agreement between the two sides. Two-thirds of each side of a board to form a quorum.

5. Before a conciliation board can entertain any proposal from the employés for a change regarding any question of the nature defined in Clause 1, affecting any class of employés, an application for such change must previously have been made through the chief officer of tramways to the Highways Committee in the usual course.

Where the Council proposes to make a change involving a reduction in wages or an increase in hours of labour affecting any class of employés, not being a change for which application has been made by the employés as aforesaid, reasonable notice of such proposed change shall be given to the employés by circular, posted notices or any other usual method, through the officers of the department concerned.

6. After any such application has been made by the employés they shall be informed, as soon as practicable, and in any case within two months, of the Council's decision with regard to the request or of its desire to refer it to a conciliation board; and similarly in the case of a notice by the Council of a proposed change, the employés shall intimate within the period allowed by the notice whether they agree to the proposal or desire that it shall be referred to a conciliation board. In the event of the decision not being accepted or of no reply being received within the specified time, the men or the Council, as the case may be, may require the matter to be referred to a conciliation board, which shall be convened to consider the matter so referred, or a change proposed by the Council, if uncontested by the employés, may be brought into operation. For the purpose of this clause, the periods during which the Council is in recess shall not count.

7. Any proposal agreed to by a sectional board, or by the central board, involving increased expenditure shall be placed before the Highways Committee and the Council for their acceptance within 28 days of the proposal, except during the recess periods of the Council, and failing its acceptance by the Council shall be referred as follows; that is to say—

   (1) A proposal agreed to by a sectional board and not accepted by the Council shall be referred to the central board; and

   (2) A proposal agreed to by the central board and not accepted by the Council shall be referred to arbitration.

Any proposal agreed to by a sectional board, or a central board, involving a reduction of rates of wages shall be communicated to the employés, and if rejected by them within a month shall be referred as follows; that is to say—

   (1) A proposal agreed to by a sectional board and rejected by the employés shall be referred to the central board; and

   (2) A proposal agreed to by the central board and rejected by the employés shall be referred to arbitration.

Except as otherwise herein provided the decision of the sectional board, or of the central board, shall be final and binding on the parties, and no decision shall be reopened within 12 months.

8. In cases in which the central conciliation board fail to agree, the meeting of that board shall be adjourned, and, if the two sides of the board fail to agree upon an arbitrator, either of them may make application to have an arbitrator appointed in terms of Sec. 9 of the General Principles. After such arbitrator has been appointed, he shall fix a date for the adjourned meeting, at which he shall preside as chairman. After hearing the matter in dispute in such manner as he may think fit, he shall within one month give his decision, which shall be final and binding on both parties for such period as the arbitrator shall determine. For the purpose of this clause the periods during which the Council is in recess shall not count.

9. In cases in which the central conciliation board have agreed, but in which their decision is not accepted by the Council or by the employés, as provided in Clause 7 hereof, if the two sides of the central conciliation board fail to agree upon an arbitrator, either of them may make application to have an arbitrator appointed in terms of Sec. 9 of the General Principles. After such arbitrator has been appointed, he shall fix a date for a meeting, at which he shall preside as chairman. After hearing the matter in dispute in such manner as he may think fit, he shall within one month give his decision, which shall be final and binding on both parties for such period as the arbitrator shall determine. For the purpose of this clause the periods during which the Council is in recess shall not count.

10. Where any question is referred to an arbitrator, all procedure in connection with the hearing of the case shall be settled by the arbitrator. Each side of the central conciliation board may select such person or persons as may be considered desirable for the purpose of representing the Council or the employés, as the case may be, at the arbitration proceedings. Counsel or other legal persons shall not be entitled to appear before the arbitrator, except with the consent of the arbitrator and at the joint request of both parties. When an arbitration takes place, the expenses of the arbitration shall be borne by the Council and its employés in such proportions as the arbitrator shall decide.

11. The question of the payment of wages and travelling expenses of employés when engaged in the business of the conciliation boards and the other expenses of the said boards shall be determined by the sectional or central boards in conformity with the procedure under which other questions are dealt with by those boards.

Duration of Scheme.

The present scheme to be in force until six months after notice has been given by one side to the other to terminate it. No such notice to be given before October 31st, 1912, except by mutual consent.

Interpretation.

1. If any question should arise as to the interpretation of this scheme, it shall be decided by the Board of Trade.

2. If any question should arise as to the interpretation of an arbitrator's award, it shall be referred for decision to the central board, or a committee appointed by the central board, and, failing agreement, to the arbitrator.

A. Shirley Benn, *Chairman.*

TRADE STATISTICS OF CANADA.

The following figures showing the imports into, and exports from, Canada of electrical and similar materials during the year ended March 31st, 1909, are taken from the recently issued trade statistics; figures for the year 1907-8 are given for purposes of comparison and notes of any increases or decreases have been added :—

	1907-8. Dollars.	1908-9. Dollars.	Increase or decrease. Dollars.
Brass ware, plain.—			
From Great Britain ...	7,000	44,000	+ 37,000
„ Germany	—	3,000	+ 3,000
„ United States ...	26,000	5,000	— 21,000
„ Other countries ...	—	1,000	+ 1,000
Total ...	33,000	53,000	+ 20,000
Railway passenger cars.—			
From United States ...	227,000	227,000	—
Tram or horse cars.—			
From United States ...	9,000	21,000	+ 12,000
Celluloid manufactures.—			
From Great Britain ...	15,000	8,000	— 7,000
„ Germany	4,000	3,000	— 1,000
„ United States ...	21,000	35,000	+ 14,000
„ Other countries ...	9,000	3,000	— 6,000
Total ...	49,000	49,000	—
Coal bituminous.—			
From Great Britain ...	11,000	140,000	+ 129,000
„ United States ...	14,788,000	13,011,000	— 1,777,000
„ Japan	44,000	—	— 44,000
Total ...	14,843,000	13,151,000	— 1,692,000
Copper wire, plain, tinned or painted.—			
From Great Britain ...	1,000	1,000	—
„ United States ...	38,000	36,000	— 2,000
Total ...	39,000	37,000	— 2,000
Electric light carbons and carbon points.—			
From Great Britain ...	2,000	3,000	+ 1,000
„ Austria	1,000	3,000	+ 2,000
„ Germany	12,000	15,000	+ 3,000
„ United States ...	29,000	24,000	— 5,000
„ Other countries ...	1,000	1,000	—
Total ...	45,000	46,000	+ 1,000
Electric apparatus not mentioned—insulators, electric and galvanic batteries, telegraph and telephone instruments.—			
From Great Britain ...	49,000	66,000	+ 17,000
„ Austria	1,000	2,000	+ 1,000
„ France	5,000	5,000	—
„ Germany	6 000	5,000	— 1,000
„ Sweden	4,000	1,000	— 3,000
„ United States ...	2,236,000	1,550,000	— 686,000
„ Other countries ...	5,000	1,000	— 4,000
Total ...	2,306,000	1,630,000	— 676,000
Incandescent lamp bulbs, &c.—			
From Great Britain ...	15,000	1,000	— 14,000
„ Austria	4,000	7,000	+ 3,000
„ United States ...	40,000	42,000	+ 2,000
„ Other countries ...	1,000	1,000	—
Total ...	60,000	51,000	— 9,000
Electric motors, generators, dynamos and sockets.—			
From Great Britain ...	10,000	18,000	+ 8,000
„ France	1,000	4,000	+ 3,000
„ Norway	—	4,000	+ 4 000
„ Sweden	—	1,000	+ 1,000
„ United States ...	578,000	294,000	— 284,000
„ Other countries ...	4,000	—	— 4,000
Total ...	593,000	321,000	— 272,000
Lamp chimneys, glass shades and globes.—			
From Great Britain ...	4,000	4,000	—
„ Austria	20,000	17,000	— 3,000
„ Germany	15,000	16,000	+ 1,000
„ United States ...	118,000	104,000	— 14,000
„ Other countries ...	1,000	1,000	—
Total ...	158,000	142,000	— 16,000
Rubber belting.—			
From Great Britain ...	1,000	2,000	+ 1,000
„ United States ...	35,000	31,000	— 4,000
Total ...	36,000	33,000	— 3,000
Manufactures of india-rubber and gutta percha.—			
From Great Britain ...	100,000	80,000	— 20,000
„ Austria	16,000	7,000	— 9,000
„ France	5,000	4,000	— 1,000
„ Germany	26,000	21,000	— 5,000
„ United States ...	353,000	333,000	— 20,000
„ Other countries ...	—	1,000	+ 1,000
Total ...	500,000	446,000	— 54,000
Locomotives for railways.—			
From Great Britain ...	—	6,000	+ 6,000
„ United States ...	1,238,000	378,000	— 860,000
Total ...	1,238,000	384,000	— 854,000
Gasoline engines.—			
From Great Britain ...	74,000	17,000	— 57,000
„ United States ...	619,000	698,000	+ 79,000
Total ...	693,000	715,000	+ 22,000
Steam engines.—			
From Great Britain ...	76,000	38,000	— 38,000
„ United States ...	347,000	196,000	— 151,000
Total ...	423,000	234,000	— 189,000
Boilers.—			
From Great Britain ...	187,000	31,000	— 156,000
„ United States ...	510,000	123,000	— 387,000
Total ...	697,000	154,000	— 543,000
All machinery not mentioned except sewing machines, textile machinery, printing machinery, &c.—			
From Great Britain ...	677,000	503,000	— 174,000
„ France	16,000	41,000	+ 25 000
„ Germany	138,000	37,000	— 101,000
„ United States ...	7,167,000	4,925,000	— 2,242,000
„ Other countries ...	7,000	11,000	+ 4,000
Total ...	8,005,000	5,517,000	— 2,488,000
Iron and steel wire, single or several, covered with cotton, linen, silk, rubber or other material, including cable so covered.—			
From Great Britain ...	173 000	162,000	— 11,000
„ United States ...	264,000	110,000	— 154,000
„ Other countries ...	5,000	6,000	+ 1,000
Total ...	442,000	278,000	— 164,000
Iron and steel wire, not mentioned (except fencing wire).—			
From Great Britain ...	52,000	16,000	— 36,000
„ Germany	63,000	23,000	— 40,000
„ United States ...	194,000	93,000	— 101,000
„ Other countries ...	1,000	5,000	+ 4,000
Total ...	310,000	137,000	— 173,000
Belting.—			
From Great Britain ...	182,000	136,000	— 46,000
„ U.S.A.	4,000	3,000	— 1,000
Total ...	186,000	139,000	— 47,000
Lighting fixtures of metal, including electric light fixtures of metal.—			
From Great Britain ...	12,000	21,000	+ 9,000
„ Austria	4,000	26,000	+ 22,000
„ U.S.A.	372,000	295,000	— 77,000
„ Other countries ...	11,000	11,000	—
Total ...	399,000	353,000	— 46,000
Asbestos Manufactures.—			
From Great Britain ...	22,000	18,000	— 4,000
„ U.S.A.	165,000	160,000	— 6,000
„ Other countries ...	3,000	3,000	—
Total ...	191,000	181,000	— 10,000

	1907-8.	1908-9.	Increase or decrease.
	Dollars.	Dollars.	Dollars.
Plumbago, ground and manufactures.—			
From Great Britain ...	4,000	2,000 —	2,000
U.S.A.	27,000	26,000 —	1,000
Total ...	31,000	28,000 —	3,000
Exports			
Mica.—			
To Great Britain ...	61,000	69,000 +	8,000
„ U.S.A	271,000	137,000 —	134,000
„ Other countries ...	6.000	3,000 —	3,000
Total ...	338,0 0	209,000 —	129,000
Electrical apparatus.—			
To Great Britain ...	3,000	4,000 +	1,000
„ Newfoundland ...	3,000	11,000 +	8,000
„ France...	2,000	3,000 +	1,000
„ U.S.A.	83,000	63,000 —	20,000
„ Other countries ...	5,000	2,000 —	3,000
Total ...	96,000	83,000 —	13,000
India-rubber manufactures.—			
To Great Britain ...	11,000	8,000 —	3,000
„ Newfoundland ...	3,000	3,000 —	—
„ New Zealand ...	6,000	5,000 —	1,000
„ U.S.A.	31,000	86,000 +	55,000
„ Japan	15,000	— —	15,000
„ Other countries ...	4,000	2,000 —	2,000
Total ...	70,000	104,000 +	34,000
Machinery.—			
To Great Britain	69,000	40,000 —	29,000
„ Newfoundland... ...	29,000	29,000	—
„ New Zealand	28,000	21,000 —	7,000
„ Argentine	26,000	15,000 —	11,000
„ France	23,000	10,000 —	13,000
„ United States	584,000	441,000 —	143,000
„ Other countries ...	145,000	33,000 —	112,000
Total ...	904,000	589,000 —	315,000

N.B.—Dollars = 4s. 2d.

THE PHYSICAL SOCIETY'S EXHIBITION.

(*Continued from page* 1014.)

R. W. Paul.

Mr. Paul showed several novelties. One was the Sumpner reflecting electrodynamometer (fig. 11), invented by Dr. W. E. Sumpner for accurately measuring a large range of small alternating voltages, and for use in connection with various bridge methods for induction measurements and similar purposes. The indications of the instrument are independent of wave-form and frequency, and are unaffected by external fields, these results being obtained by the use of an iron magnetic circuit of special form. The great range and high sensitivity possible with this form of dynamometer open up a new sphere of electrical measurements.

The magnetic circuit is constructed of thin laminations of iron, of high resistance and low hysteresis. The instrument is designed so that the field flux is accurately proportional to, and in quadrature with, the voltage applied to the magnet coil. The moving coil has few turns, and therefore low self-inductance; it is freely suspended by a phosphor-bronze strip, which acts as a control, and is fitted with a vane working in a closed chamber, which gives effective air-damping.

The magnet is wound with three coils, to enable high sensibility to be obtained for various applications of the instrument.

To use the instrument for the measurement of small voltages, one of the magnet coils is connected across the voltage to be measured, while the moving coil, in series with a condenser, is connected across the same or another of the magnet windings. The deflection is proportional to the square of the applied voltage, and directly proportional to the capacity used in the moving-coil circuit. The range of the instrument is enormous, and can be varied by altering the connections of the coils and also by varying the capacity.

The sensibility of the instrument can be further increased by using it heterostatically, *i.e.*, exciting the magnet with a high voltage from the same source as the voltage to be measured. It then becomes possible to detect voltages smaller than one micro-volt. A pressure of 200 volts at 50 cycles may be applied to the fine-wire coils in series without injuring them.

By applying a known alternating voltage to the magnet winding and also to the moving coil in series with the condenser under test, the instrument may be used for the measurement of capacities, the deflection being proportional to the capacity tested. The instrument can also be used for the investigation of the magnitude of "skin effect" in a conductor, and for the measurement of very small amounts of power, with the aid of a suitably-designed quadrature transformer.

A new model of the Campbell vibration galvanometer was shown in action; compared with the original pattern, its coil is very much smaller and lighter, having only 30 turns of wire and a total resistance, including suspensions, of about 3 ohms. Nevertheless,

Fig. 11.—Sumpner Reflecting Electrodynamometer.

it can be tuned to any frequency from 50 to 1,000 periods, and at 100 periods its sensitivity is such that $\frac{1}{10}$th of a micro-ampere can be detected. The suspensions are of bronze wire, and form connections to the coil, thus eliminating the damping effect of the flexible connections previously employed. The effective length of the upper, or bifilar, suspension can be varied at will, and a separate adjustment of the tension on the suspension is provided.

The Campbell inductance standards and bridge were shown in use for measuring inductances and capacities for wave telegraphy. Their range of usefulness has been greatly extended by the development of a system of unequal ratio arms, so that inductances and capacities of any value may now be measured by direct-reading methods with almost as much simplicity as the measurement of resistance by the Wheatstone bridge.

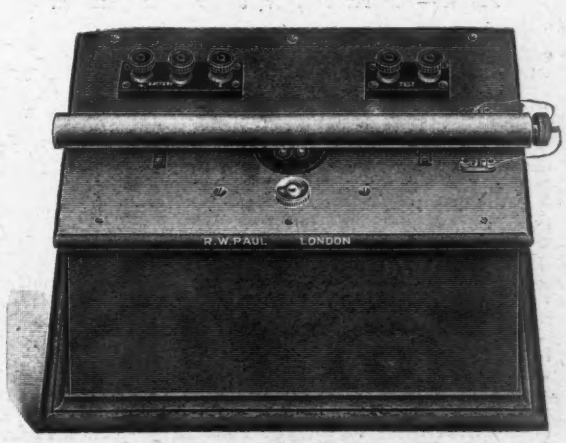

Fig. 12.—Microphone Hummer.

As a source of small alternating current of known high frequency for testing purposes, the microphone hummer (fig. 12) was exhibited. It consists of a bar of steel resting on nodal points near its extremities, and carrying a microphone button shunted by a condenser. A transformer is connected in circuit, the secondary current passing through a coil on a polarised magnet under the bar. On striking the bar, an alternating current passes round the magnet and maintains the vibration. The testing current is taken from another secondary winding; its frequency depends on the length of the bar selected, and may be 1,000, 2,000 or upwards. The instrument is self-contained, and needs only to be connected to a 6-volt battery to be ready for use. A special telephone receiver for use with the selected frequency is supplied, the diaphragm being arranged

to resonate to it, thereby increasing the sensitivity and the sharpness with which a null point may be detected when testing; this is also aided by the comparative freedom from higher harmonics of the current from the hummer, and its unvarying frequency.

Some new models of the single-pivot moving-coil instruments invented a few years ago by Mr. Paul were exhibited; these have been simplified and fitted into teak cases, so as to render them more suitable for rough use and for elementary students (fig. 13). An interesting extension of the single-pivot principle to A.C. measurements has been made; the circular coil with its central pivot moves in a spherical space between two fixed coils, thus forming a sensitive dynamometer. One of the new instruments, giving a full scale deflection for 8 milliamperes, was exhibited, and other forms are made as ammeters, voltmeters, and wattmeters with various ranges. As there is practically no metal used in the construction, except in the coils, this dynamometer is particularly suitable for the accurate measurement of small powers.

The Optiphone, an attachment by means of which the vibrations of a telephone diaphragm are magnified and made visible to the eye, with the aid of the device invented by Mr. Irwin for his oscillograph, was shown at work; we hope to describe this more fully later.

A potentiometer, designed by Mr. Melsom, of the National Physical Laboratory, was exhibited. It has 150 coils, and is operated by six dials with switches, so arranged as to give direct reading in conjunction with a short slide wire. The balance to standard cells can be checked at any moment by simply pressing a key, without disturbing the test in hand, and compensation for the varying temperature of the standard cell is provided. The rheostat is of new design, giving great steadiness of adjustment, and in order to render the slide wire easily replaceable, it is adjusted by shunting.

A potentiometer for extra-high pressures, fitted with Duddell-Mather non-inductive anti-capacity resistance gauze, was exhibited, forming one section of a set for use at the National Physical Laboratory; it had a resistance of 100,000 ohms, sub-divided into four

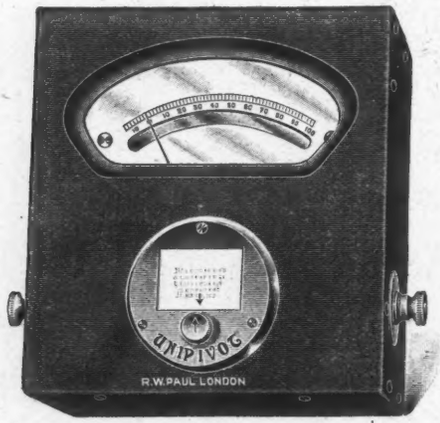

Fig. 13.—"Unipivot" Moving-Coil Galvanometer.

divisions of 20,000 ohms, and 10 of 2,000, connected to highly-insulated sockets for travelling plugs. The gauze, which had a length of 30 ft., and a width of 7 in., was mounted on long porcelain bobbins enclosed in a framework, and protected by wire-work panels; each division was accurately adjusted to within one part in 10,000. This particular section was capable of independent use on a 10,000-volt circuit, or of being coupled up to others for higher pressures.

A number of other instruments and accessories was also exhibited.

Siemens Bros. & Co., Ltd.

Messrs. Siemens Bros.' exhibits would form a lengthy list, including various types of ammeter and voltmeter, the Universal galvanometer, portable current transformer, collapsible photometer, and other measuring apparatus. Amongst the items of especial interest was the Saladin double-mirror galvanometer, which we mentioned last year, and now illustrate (fig. 14). This instrument is ingeniously arranged for the purpose of reproducing a curve on a stationary photographic plate. It consists of two galvanometers, the mirrors of which are optically connected by means of a prism. The horizontal movement of the beam of light from the mirror of the first instrument is converted by the prism into a vertical movement, and the light is then thrown on to the mirror of the second instrument, where its vertical movement is combined with the horizontal movement of the mirror of the latter. The resultant of the horizontal and vertical movements gives the required curve. The apparatus can be worked for any speed of the ray of light up to 2·5 mm. per second, and with photographic plates of ordinary sensitiveness.

A typical example of the application of the instrument is to the determination of the recalescence points in metals. One galvanometer is connected directly to a pyrometer giving the temperature of a metal which is known to have no recalescence points; the other is connected across both this and another pyrometer, recording the temperature of the metal under test, so that the latter galvanometer measures the difference in temperature at any

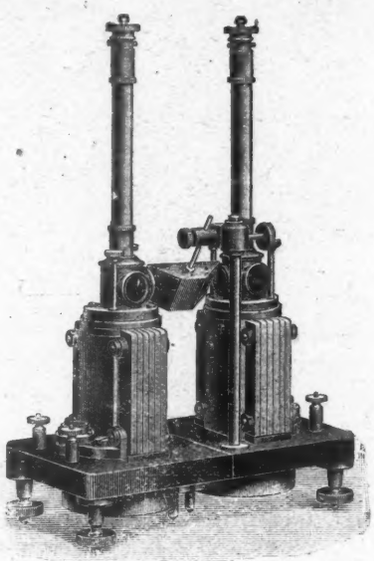

Fig. 14.—Saladin Double-Mirror Galvanometer.

moment between the two metals. Thus a curve between actual temperature and difference of temperature is described by the spot of light, showing clearly the recalescence points, and recording the curve on a photographic plate.

Another interesting exhibit was a high-frequency generator, for a normal frequency of 3,500 cycles per second (fig. 15). This was provided with a loading generator, instead of the eddy-current

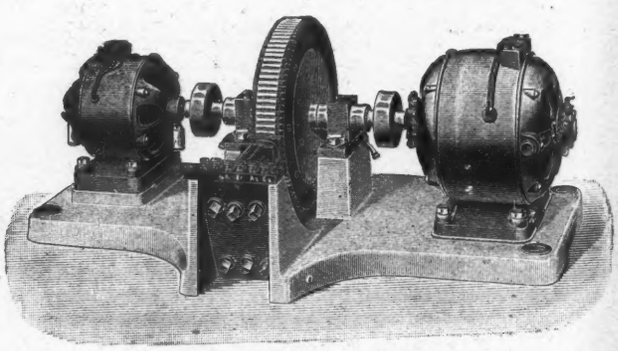

Fig. 15.—High-frequency Generator.

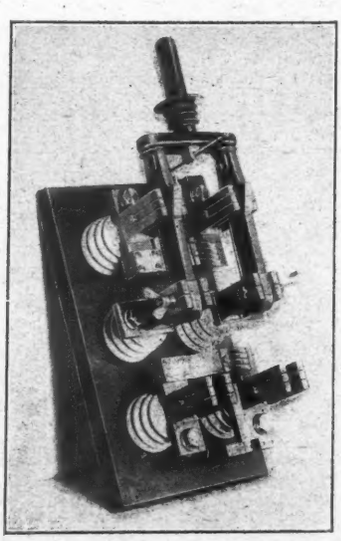

Fig. 16.—Change-over Switch for 400 Amperes at 6,000 Volts.

brake, as shown last year, and was driven by a motor. On a 220-volt circuit, a maximum frequency of 6,000 cycles per second could be attained.

A large change-over switch was exhibited, which was specially designed for measuring the power in a three-phase unbalanced

circuit with a single-phase wattmeter (fig. 16). The capacity of the switch was 400 amperes at 6,000 volts. By an ingenious arrangement the contacts are short-circuited until the blades of the switch connected with the wattmeter are practically home, so that the main

Fig. 17.—Siemens Ohm-meter, with Generator.

circuit is never interrupted for a moment, and the change-over can be effected instantly.

Other noteworthy exhibits were the Frahm speed and frequency indicators, of the vibrating reed type, which Messrs. Siemens Bros. now supply; and an ohm-meter, operated either with a generator, fig. 17 (up to 1,000 volts), or direct from the supply mains at 220 or 440 volts.

Nalder Bros. & Thompson, Ltd.

At this stand there was a variety of electrical measuring apparatus. The Telethermometer, the Ohmer, portable D.C. testing sets, the limit indicator (described in our issue of November 26th, page 865), and a number of switchboard instruments, were shown. A recording wattmeter was exhibited, suitable for use on three-phase

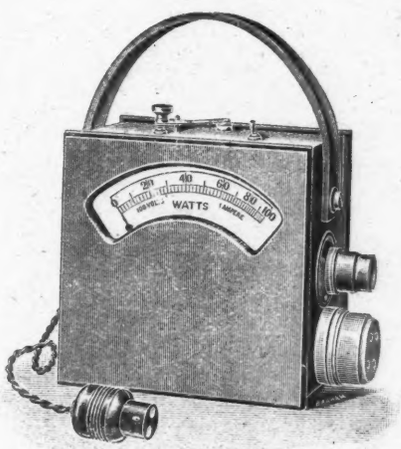

Fig. 18.—Lamp-testing Wattmeter.

unbalanced circuits, being fitted with two movements on the same spindle, arranged to avoid mutual effects. We illustrate a lamp-testing wattmeter of the moving-coil type, designed for a very low power consumption, and to read accurately on both A.C. and D.C. circuits.

F. Harrison Glew.

Mr. Glew showed an interesting application of the properties of radium to the collection of atmospheric electricity. A metallic spiral, coated with a radium salt, was suspended from an insulator on the top of the building, and connected with an electroscope; the radium ionised the surrounding air, and allowed the aerial conductor to acquire the potential of the air at that point, thus charging the electroscope. The latter automatically discharged itself to earth every few seconds through a coherer, causing a bell to ring. Another exhibit was an arrangement for recording the number of sparks passed during a short interval of time by an induction coil, as in instantaneous X-ray photography. For this purpose a steel ball was allowed to roll down inclined rails on to a horizontal track consisting of two graduated straight-edges, one of which was covered with a strip of paper. The sparks passed from the rolling ball to the rail through the paper, perforating the latter and thus recording the number and frequency of the sparks.

Electrical Regulators and Economisers, Ltd.

A number of the Martin rheostats was exhibited at this stand including, besides the standard type which we have illustrated, patterns suitable for shunt-field regulation, elementary laboratory use, and a stage-lighting dimmer to carry 40 amperes, consisting of nine columns of 12 cells each. One of the regulators was fitted up in series with a wattmeter and a lamp, to show the extremely wide range over which the instrument was effective.

(To be continued.)

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

JAPAN—*(concluded)*.

Electric, horse and other tramway cars, and parts, regulators and motors for electric cars, trolley wheels and poles, electric motor trucks, Gans's patent motor cars, inspection cars	20 % ad. val.
Instruments: physical, chemical, surgical, surveying, and other scientific instruments	20 % „
Amperemeters, voltmeters, galvanometers, wattmeters, ohmmeters, &c.	20 % „
Telegraphic and telephonic instruments and parts thereof, including transmitters, perforators, relays, citophones, logphones, field telephones, telautographs, speaking tubes, receivers	20 % „
Boilers and arranged boiler tubes for water-tube boilers...	15 % „
Steam engines, gas engines, petroleum engines, electric motors and other motive power machines, hydraulic engines, water turbines, steam turbines, Pelton wheels, air engines, electric dynamos, pistons, piston rings, governors, condensers, armatures, carbon and copper brushes for electric dynamos, oil furnace for petroleum engines and parts thereof	15 % „
Carbon rods for electric light, including coppered carbon rods... ...	6·86 yen per 100 kin
India-rubber or caoutchouc: crude ...	Free
Plates and sheets, *soft*, not exceeding 1 mm. thickness	87·80 yen per 100 kin
Others	35·90 „ „
Hard	37·80 „ „
Rods	10 % ad val.
Other, unmanufactured	10 % „
Gutta-percha: crude	Free
Plates and sheets	39·40 yen per 100 kin
Other, unmanufactured	40 % ad val.
Gutta-percha manufactures	40 % „
Caoutchouc manufactures	10 % „
Celluloid bars, rods, plates, &c. ...	25·60 yen per 100 kin
„ manufactures	40 % ad val.
Packings for engines	7·51 yen per 100 kin
Incandescent electric lamps:	
Not exceeding 32 C.P.	5·80 yen per hundred
Others	10·20 „ „
Arc light lamps, sockets and filaments for electric lamps, shades, globes, reflectors, detached parts of incandescent electric lamp sockets ...	30 % ad val.
Electric blasting fuses	25 % „
Articles not separately mentioned in the Tariff:	
Raw or unmanufactured	10 % ad val.
Partly manufactured	20 % „
Wholly manufactured:	
Coarse	30 % „
Fine	40 % „

The following articles are admitted free of duty:—Articles imported for Imperial use, samples of merchandise which are only fit for use as such, tools and instruments of professional necessity to settlers.

Electric Smelting of Iron Ore.—Dr. Haanel, Director of Mines, has been advised from Norway of the early erection in that country of a second works for the reduction of iron ore by the electric furnace. Dr. Haanel has also been requested by Director H. Boholm, of the Copper Mine and Smelting Co., of Trondhjem, to recommend an electro-metallurgist capable of taking charge of the erection and management of the proposed works. The recurring erection of works in Norway and Sweden for the purpose of electric smelting proves the correctness of the reports issued from time to time by the Canadian Department of Mines upon the subject.

NEW PATENTS APPLIED FOR, 1909.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

29,064. "Improvements in electric sparking plugs for internal-combustion engines and the like." A. Taylor and F. Stebbing. December 13th.

29,068. "Improvements in electric arc lamps." H. Hirst and A. E. Angold. December 13th.

29,069. "Improvements in electric arc lamps." H. Hirst and A. E. Angold. December 13th.

29,087. "Improvements in and relating to electric cartridge fuses." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) December 13th. (Complete.)

29,088. "Improvements in and relating to rotary converter dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) December 13th. (Complete.)

29,090. "Improvements in or relating to the working of single-phase commutator dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd., (Siemens Schuckertwerke G.m.b.H., Germany.) December 13th. (Complete.)

29,091. "Improvements in electric switches." H. E. Donnithorne. December 13th.

29,135. "Improvements in electromagnetic clutches for transmission of power, speed regulation and acceleration." W. P. Durtnall. December 13th.

29,200. "Improvement in controllers for electric motors." Electric Construction Co., Ltd., and F. W. Close. December 14th.

29,206. "Totally-insulated electric lamp-holder." G. D. Adam. December 14th.

29,214. "Improvements in the electro-deposition of iron." S. O. Cowper-Coles. December 14th.

29,236. "Improvements relating to electric clocks and like instruments." H. Creese. (Application for Patent of Addition to No. 3,851/09.) December 14th.

29,240. "Improvements in storage batteries." H. C. Hubbell. December 14th. (Complete.)

29,255. "Improvements in and relating to ignition systems for internal combustion engines." E. L. Weiss. (Date applied for under Sec. 91 of the Act, December 17th, 1908, being date of application in France.) December 14th. (Complete.)

29,267. "Improvements in and connected with electric motors." J. D. Roots. December 14th.

29,284. "Improvements in and relating to electric welding." E. B. Koopman. December 14th. (Complete.)

29,312. "Improvements in dynamo-electric machinery." Bruce Peebles and Co., Ltd., and P. Dornonville de la Cour. December 15th.

29,329. "Improvements in the use of magnetic generators." M. A. Codd. December 15th.

29,339. "Improvements in or relating to switches for use in electric circuits." F. Broadbent. December 15th.

29,350. "Improvements relating to conduits or casings for electric conductors." Key Engineering Co., Ltd., and L. Nagel. December 15th.

29,376. "Improvements relating to dynamo-electric machines." M. Walker. (Date applied for under Rule 13, January 11th, 1909; an invention comprised in Application No. 696, dated January 11th, 1909.) December 15th.

29,388. "Improvements in automatic electrically driven pumps for domestic water supply." M. Brandenburg. December 15th. (Complete.)

29,411. "Improvements in electrical heating apparatus." S. L. R. Price. December 16th.

29,437. "Improved electrically illuminated advertising sign." C. Gates, jun. December 18th.

29,448. "Improvements in or relating to electrical ship-log apparatus." T. Walker & Son, Ltd., T. F. Walker and T. S. Walker. December 16th.

29,481. "Improvements in wireless electric signalling particularly applicable to free aerial vessels." R. A. Fessenden. (Date applied for under Sec. 91 of the Act, February 11th, 1909, being date of application in United States.) December 16th. (Complete.)

29,496. "Improvements in and relating to the prevention of over-charge or over-discharge or of both over-charge and over-discharge of secondary batteries." R. S. Dobbie. December 16th.

29,506. "Improvements in wall and like plugs for electrical connections." A. Bonnella and G. J. Bonnella. December 16th.

29,511. "Improvements in separators of electrodes." H. F. Joel. December 16th.

29,521. "Improvements in and relating to the distribution of electrical energy." J. T. Morris. December 16th.

29,582. "Improvements connected with plug and socket connections used in electric lighting and power installations." A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. December 17th. (Complete.)

29,583. "Improved speed governing device for electric motors." R. A. Smith. December 17th.

29,584. "Improvements in tractive electro-magnets." R. A. Smith. December 17th.

29,629. "Improvements in X-ray vacuum tubes." W. M. Martin. December 18th.

29,697. "Improvements in or connected with electric call or signalling apparatus, or an instrument for calling separately by means of an electric bell several stations connected by a single wire." L. E. Belcourt and L. S. Lebret. December 18th.

29,671. "Improvements in electric furnaces." O. Vogel. December 18th. (Complete.)

29,677. "Improvements in telephone installations." Siemens Bros. & Co. and H. W. F. Ireland. December 18th. (Complete.)

29,699. "Improvements in and relating to electric motor controllers." British Thomson-Houston Co., Ltd. (General Electric Co., United States. December 18th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Apparatus for Producing Rapid Electric Oscillations. E. Von Lepel. 17,349. August 18th. (Date applied for under International Convention, August 20th, 1907.)

Manufacture of Refractory Electric Conductors. C. T. Fuller. 17,619. August 24th. (Date applied for under International Convention, August 24th, 1907.)

Magneto Ignition. J. L. Milton. 20,271. October 20th.

Regulation of Continuous-Current Motors. P. Scharf. 24,794. November 18th.

Wireless Signalling. R. A. Fessenden. 25,305. November 24th. (Date applied for under International Convention, December 23rd, 1907.)

Electric Lamps for Vehicles. E. Aron. 25,389. November 25th.

1909.

Dynamo-Electric Machines. J. Taylor. 16. January 1st.

Means for Supporting Electric Lamps. J. H. McLean. 875. January 13th.

Electric Traction Systems. E. M. Munro and Railless Electric Traction Co. 1,067. January 15th.

Trolley Heads for Electrically-Propelled Vehicles. E. M. Munro and Railless Electric Traction Co. 1,077. January 15th.

Electric Control of Lifts. J. G. Childs and T. S. Hill. 1,086. January 15th.

Electric Indicators. Julius Sax & Co. and H. C. Wheat. 1,983. January 27th.

Electric Protective Devices of the Type Suitable for Use as Lightning Arresters. British Thomson-Houston Co. (General Electric Co., United States.) 2,529. February 2nd.

Treating Wood to Render it Suitable for Use in Secondary or Storage Batteries. P. Marino. 2,641. February 3rd.

Secondary or Storage Batteries. P. Marino. 2,683. February 4th.

Apparatus for Producing but very slightly Damped Electrical Oscillations. W. P. Thompson. (Ges. für Drahtlose Telegraphie.) 6,424. March 17th.

Process for Manufacturing Electric Incandescent Lamps. R. Hopfelt. 8,146. April 5th.

Galvanic Dry Batteries. G. L. Patterson and G. H. Hopper. 11,155. May 11th.

Electric Time Alarm Apparatus. W. Rausch. 12,195. May 24th.

Electric Arc Lamps. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke Ges.) 14,505. June 21st.

Electric Locking and Unlocking Device for Locks. G. Sahmer. 15,991. July 8th.

Static Induction Generators or Influence Machines. C. Harrison. (C. E. Baker.) 21,529. September 21st.

Manufacture of Arc Light Electrodes. Geb. Siemens & Co. 23,171. October 11th. (Date applied for under International Convention, November 19th, 1908.)

Circuit Closers for Automatic Electric Burglar Alarms. H. B. Collier. 24,453. October 25th. (Date applied for under Rule 13, November 26th, 1908.)

Electricity in Swedish Industry.—According to a lecture by Dr. Sahlin, published in the *Jernkontorets Annaler*, electricity has now been introduced at about 50 iron mines and deposits for various purposes. The energy is in some cases transmitted over considerable distances, as, for instance, 50 km. to the well-known Grängesberg mine, which was one of the pioneers in the adoption of electrical energy in Swedish mines, and the first to use the three-phase system.

At these mines there are now 94 motors in work with a total capacity of 5,280 H.P., in addition to which 585 H.P. are used for lighting purposes, including 175 H.P. in the pits. The average consumption of power amounts to 4,050 H.P.

The total number of electrical motors installed in Swedish iron mines is 427, having a total capacity of 10,086 H.P.

Electricity has now been introduced at 44 iron and steel works, of which 18 are using motors for driving rolling mills. The following table is based on the official statistics of the Electrical Inspection:—

Number of motors installed	1,246
Of which are used for steel-rolling purposes	61
Total capacity of the motors	34,339 H.P.
Of which are used for steel-rolling purposes (maximum)	13,260 „
Electrical power for electrometallurgical purposes (maximum)	11,095 „
Electrical power for lighting purposes...	2,657 „
Total of the present installation	48,191 „

The last-named figures will be largely increased within a short time, when two very large transmission undertakings have been completed. The experimental works at the Trollhättan waterfalls for the electric smelting of iron ore are designed to have a capacity of 7,500 H.P.

The Buenos Ayres Exhibition.—We recently commented upon the enterprise which was being displayed by British electrical and other engineering manufacturers in booking space for the great Buenos Ayres Exhibition of next year. It appears that there is not a similar enterprise evident on the part of the United States firms, indeed, owing to the apathy shown, in spite of the efforts of the Government administration departments, the United States applications for space do not reach the minimum of 5,000 square metres, and according to the *Times* New York correspondent, the States may have no building at all at the Exhibition. Against this, put the statement that both Great Britain and Germany have already engaged 100,000 square metres, and cannot then accommodate all their representatives, and we see more plainly than ever that the fight for South American business is an Anglo-German one. By way of explanation of the American attitude, the *Times* correspondent adds:—"The reason for this situation lies in the fact that nearly all the American firms who carry on business in the Southern Continent employ foreign agents, who naturally include the exhibits of the American concerns which they represent in the buildings assigned to their own countries. It would seem obvious that if manufacturers here were really anxious to extend their business in South America they would send out their own agents. However, for various reasons it has always proved a difficult task to get the right men to go there and to retain them when they have gone." A few weeks ago in our "Notes on Trade Abroad," we alluded to a remarkable series of blunders in dealing with the South American market for which United States firms suffered a severe Consular castigation.

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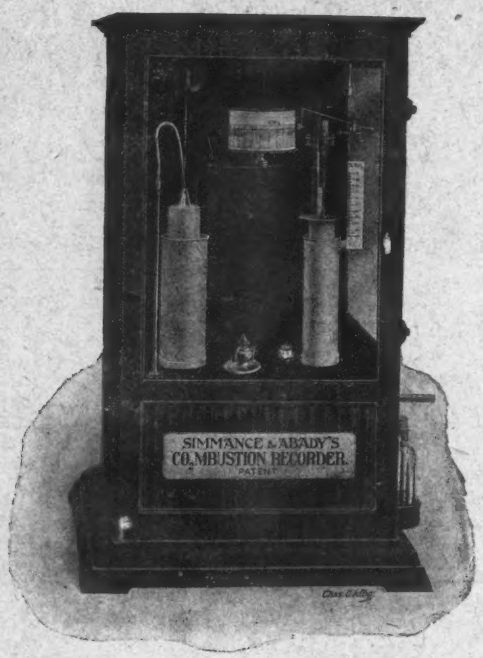

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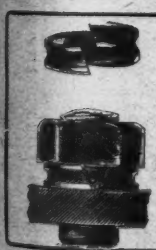

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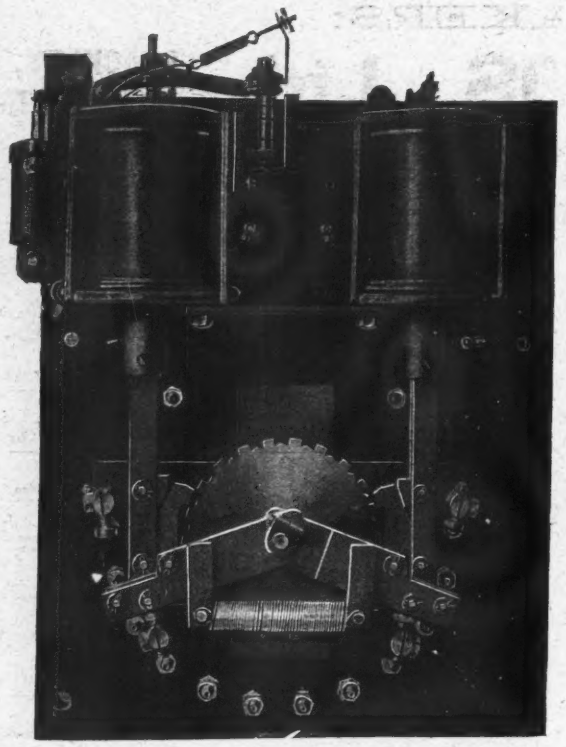

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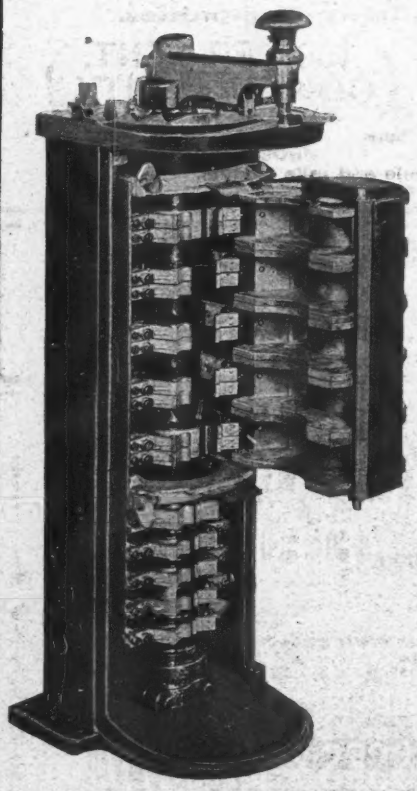

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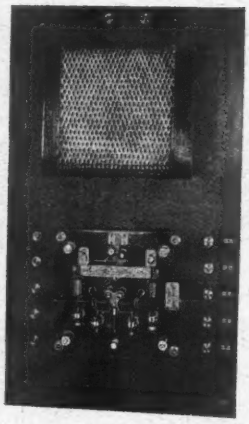

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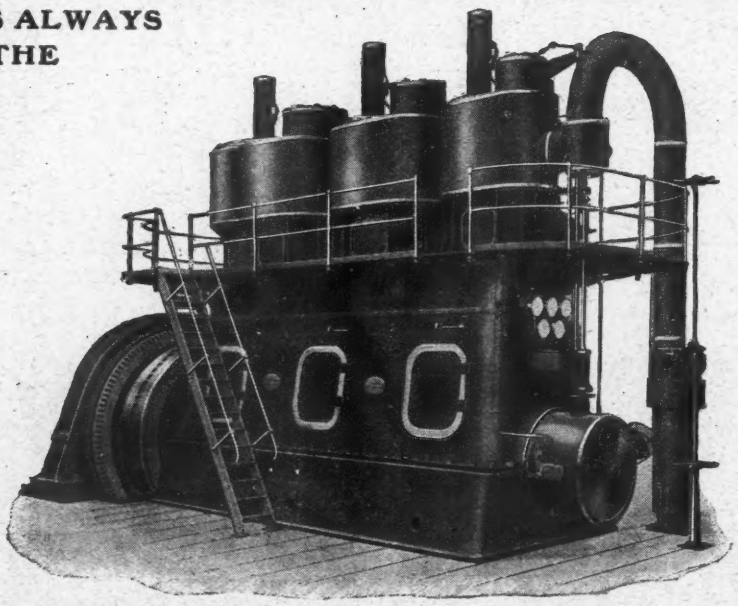

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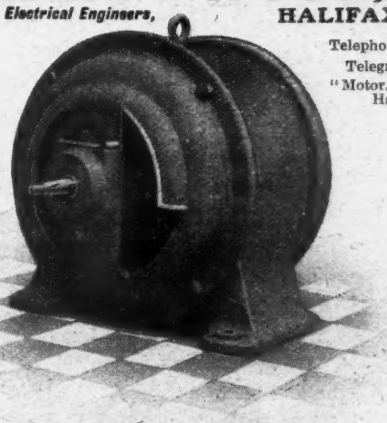

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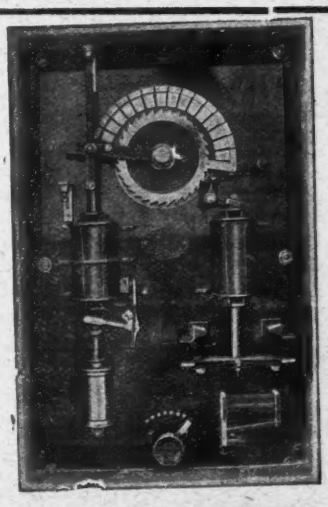

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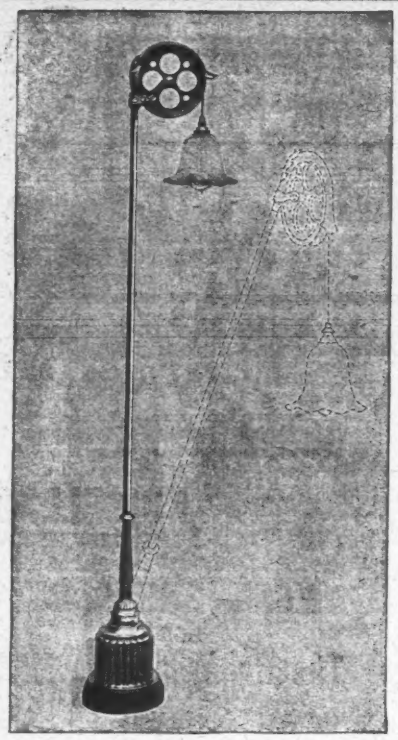

Fig. 191.

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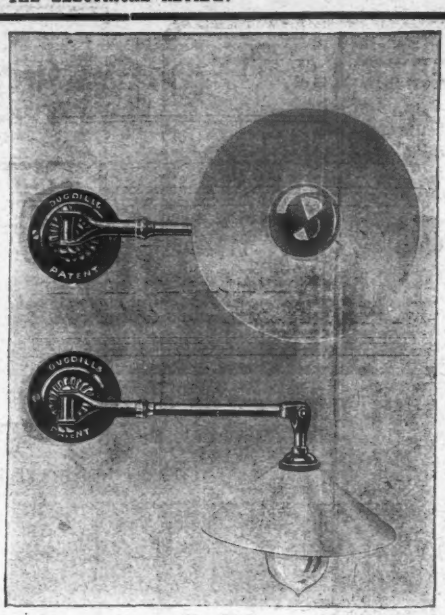

Fig. 220.

FIG. 220.

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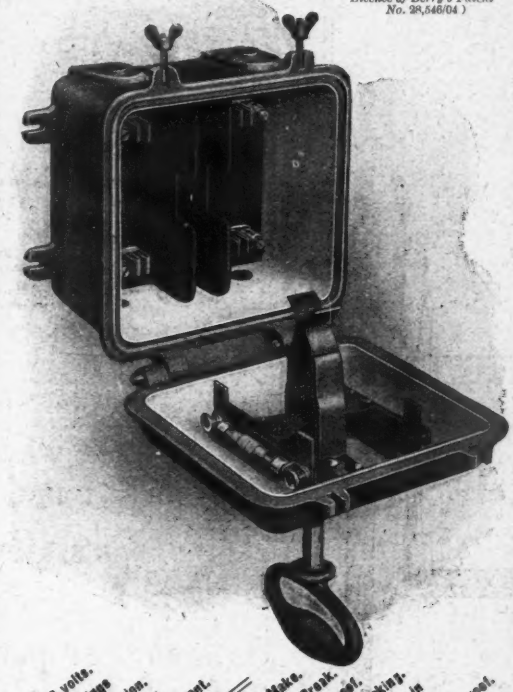

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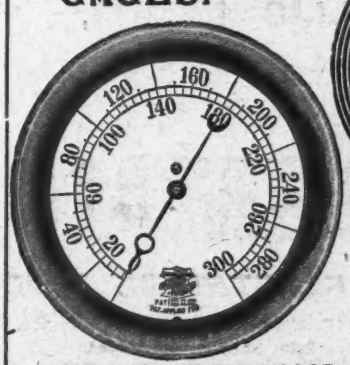

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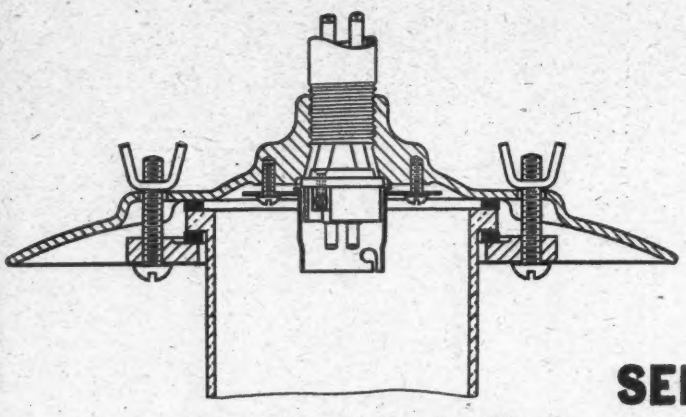

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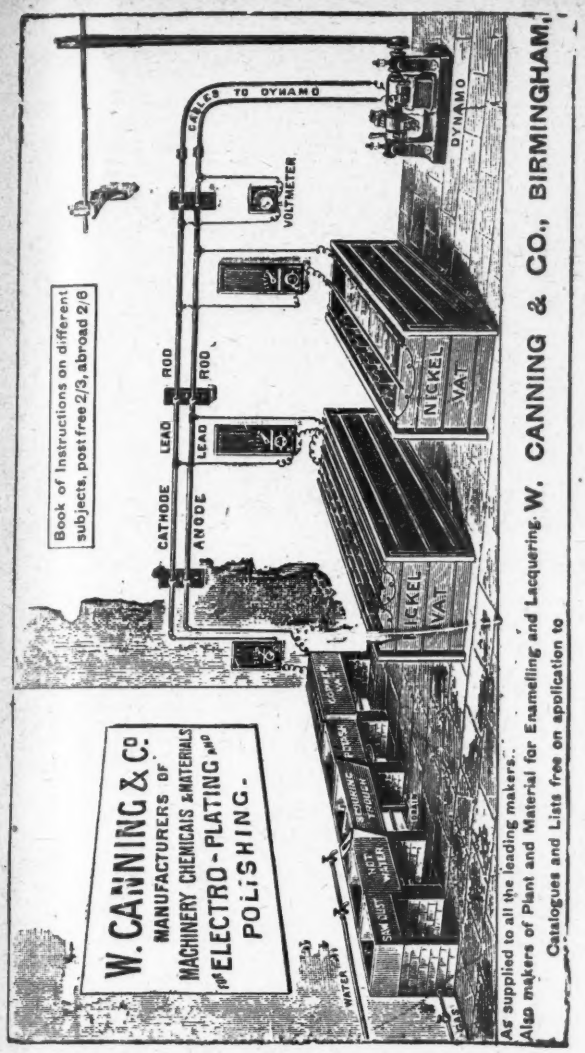

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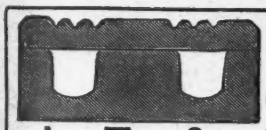

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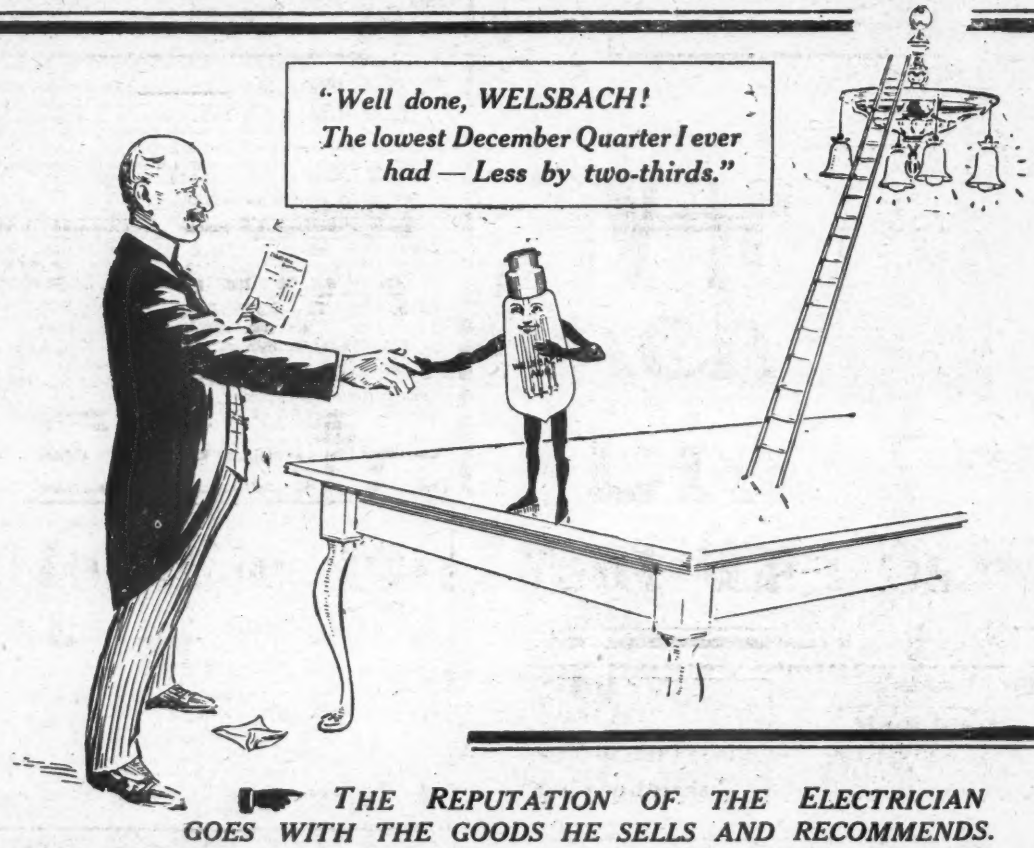

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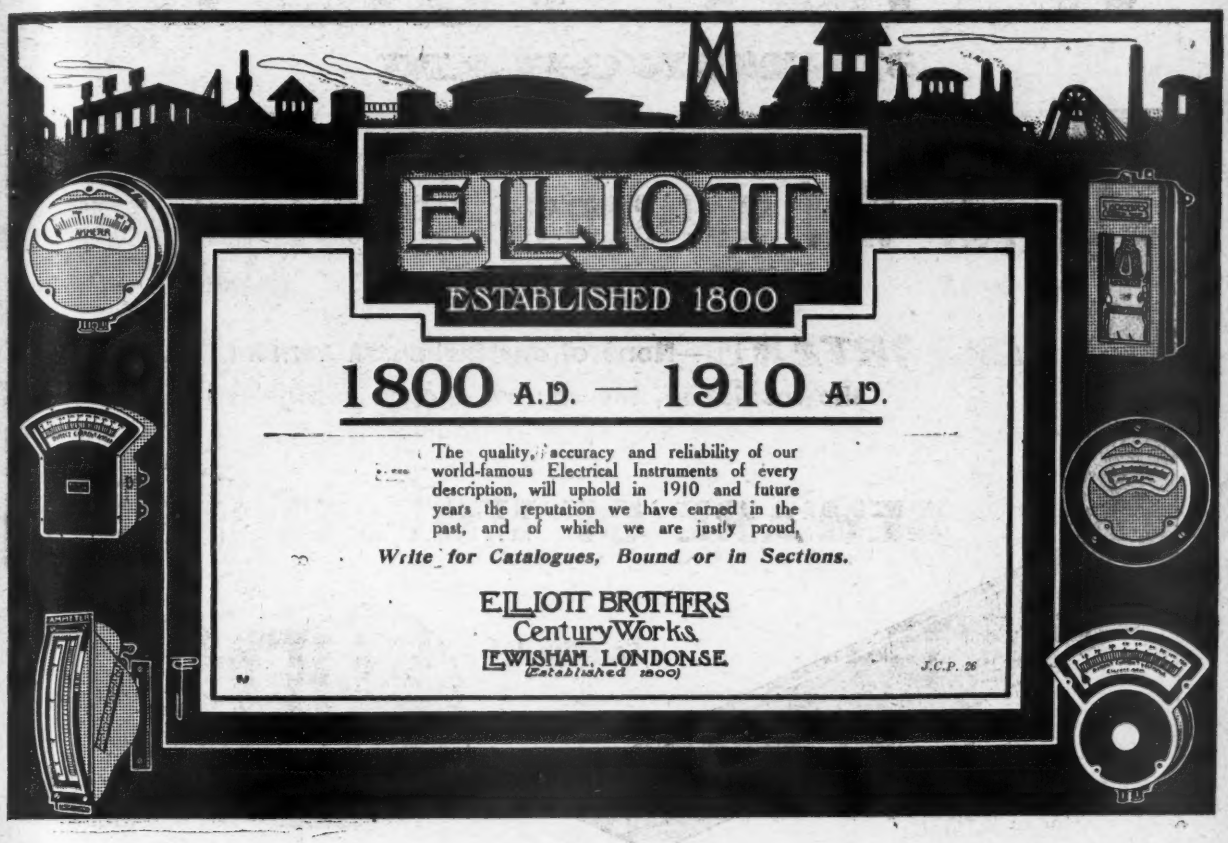
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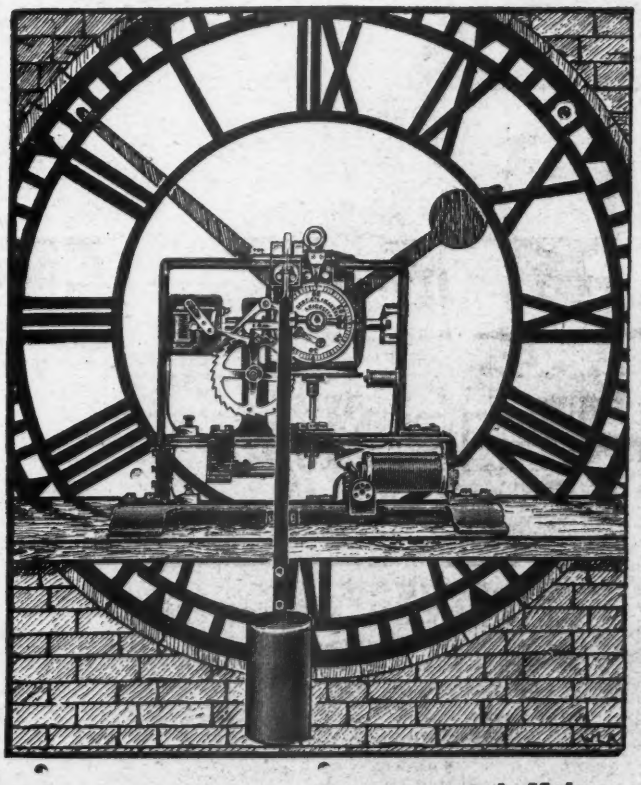

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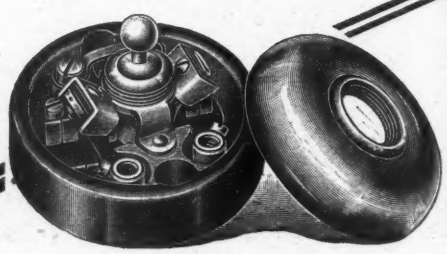

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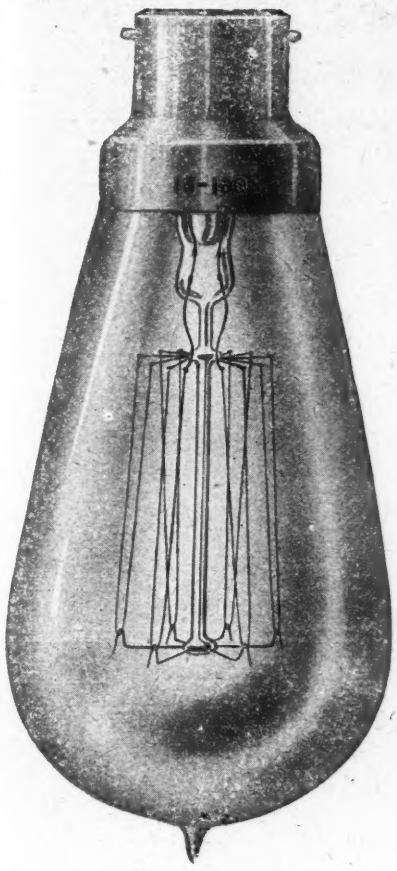

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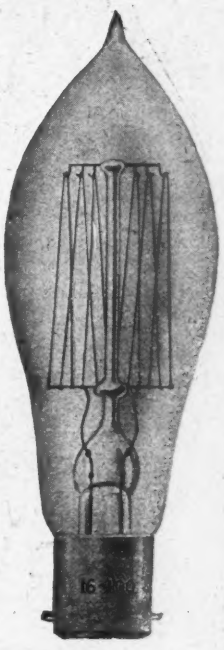

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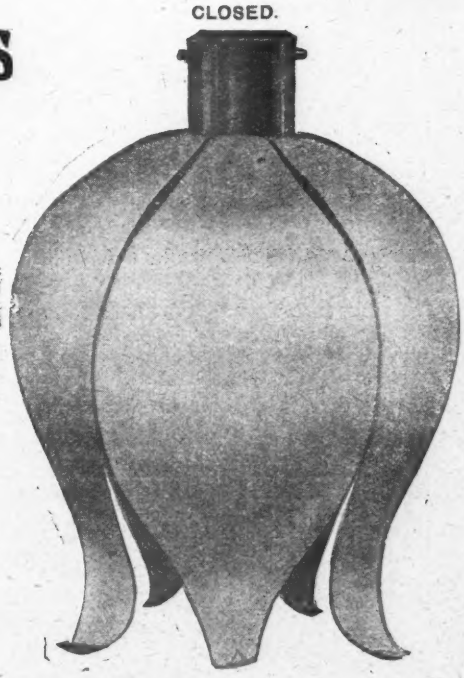

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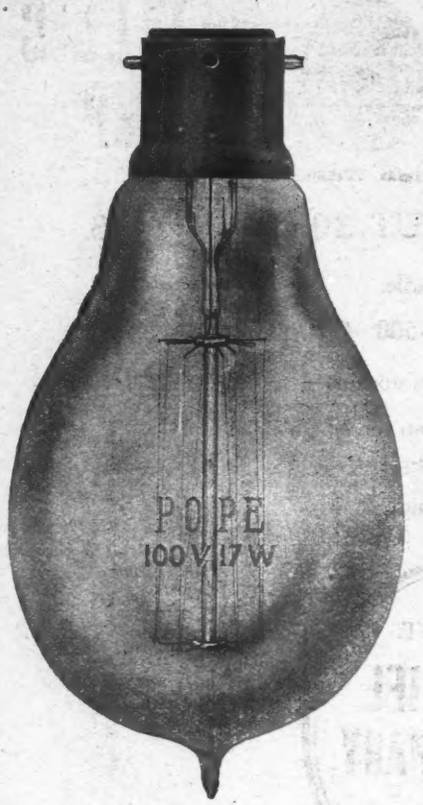

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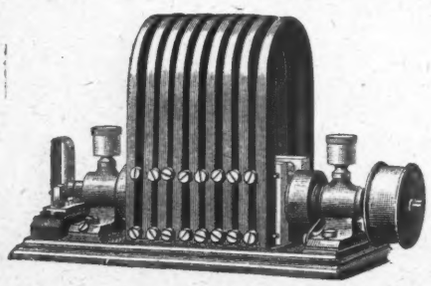

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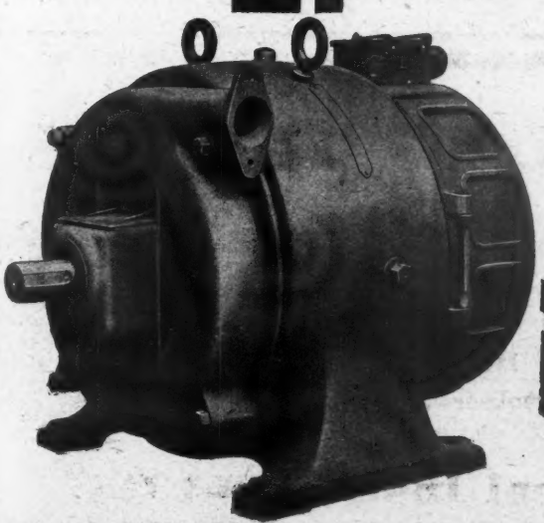

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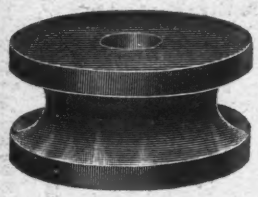

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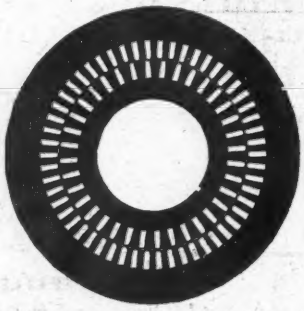

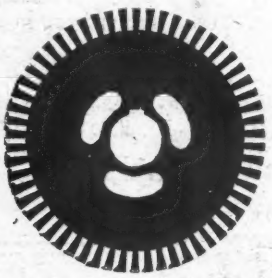

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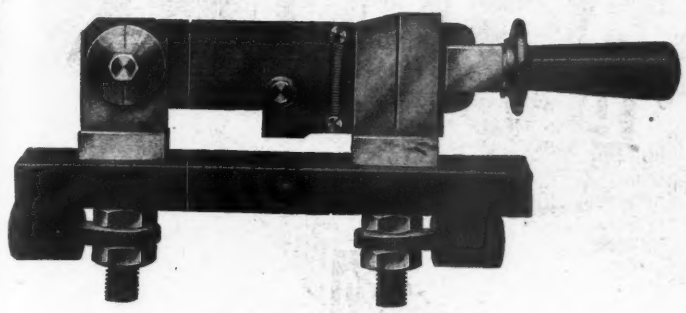

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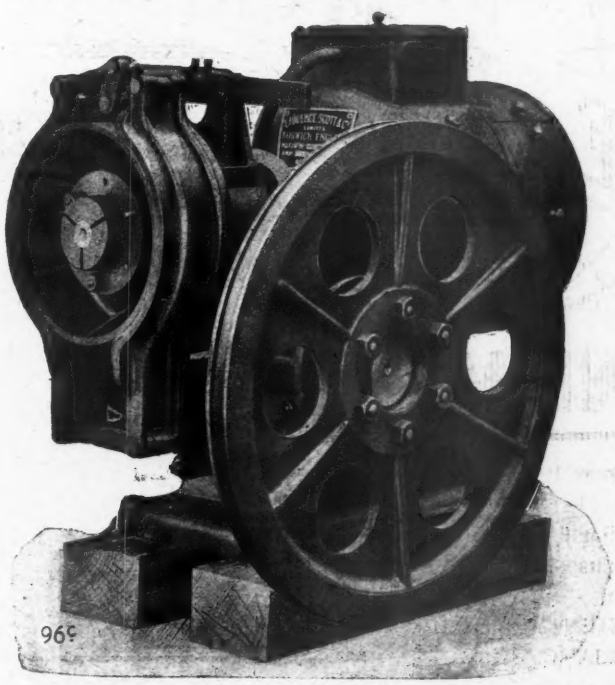

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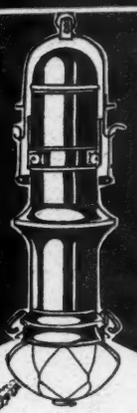

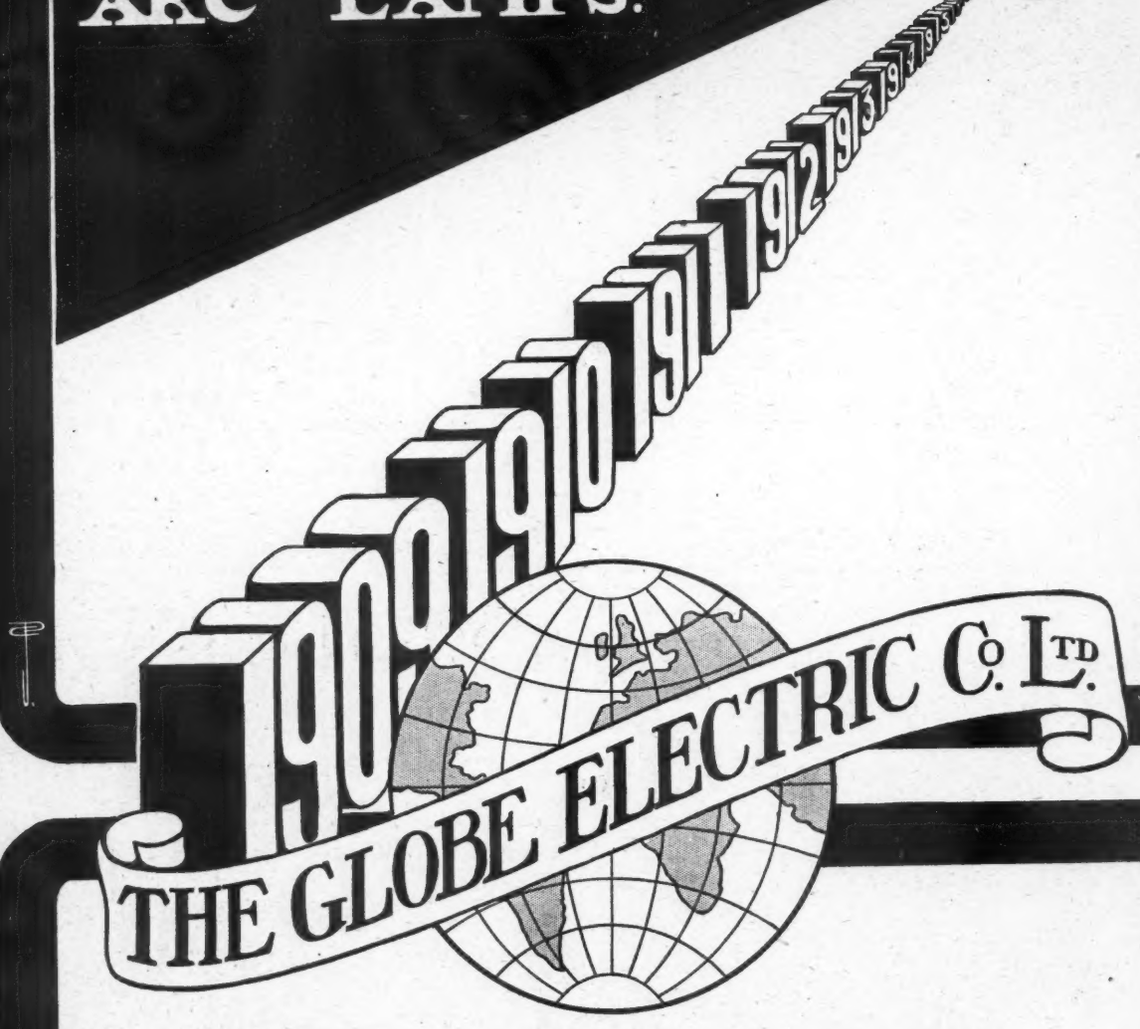

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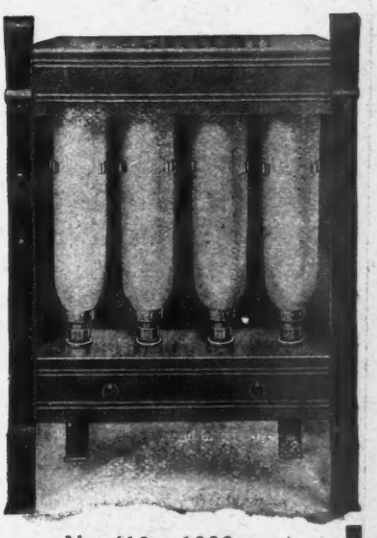

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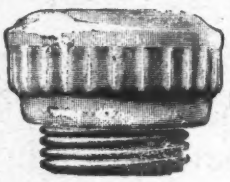

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CARTRIDGE.

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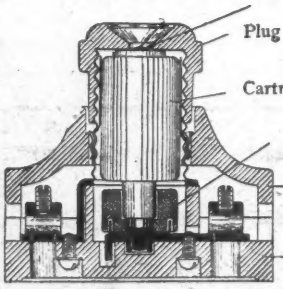
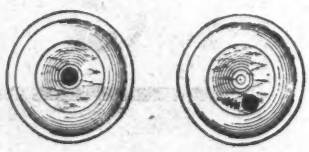
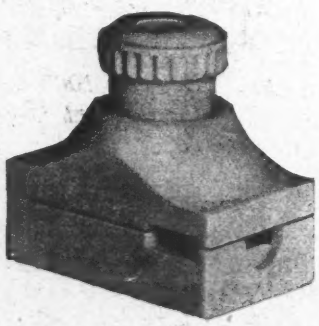




M 282

Normal appearance. Fuse blown.



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(Continued on next page.)

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AS Accountant and Bookkeeper or Assistant; 10 years' experience with one of the largest Cable Makers and Contractors. Highest testimonials.—6203, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMPETENT Accountant and Book-keeper requires engagement, used to taking entire charge of counting-house, and control over staff; balances own books, &c., &c.—Write LEYELL, 11, Sedgemere Avenue, East Finchley, N. 6221

CONTRACT Engineer (33), experienced in erection and running of complete central station plants and distribution systems, requires responsible position, some experience abroad.—Apply 6286, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRIVER, married, seeks charge; plant, steam or gas-driven, no objection to other work, abstainer, good testimonials.—6317, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Wireman wants sit., 10 years' experience, good ref.—W., 90, Pownall Road, Dalston. 6334

ELECTRICAL Engineer (20), requires situation. Technically trained. Practical experience with gas engines and dynamos. Good references.—6270, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, 20 years' general all-round experience, 2 years seagoing, last eleven years with large corporation electric supply department, seeks new appointment as foreman or otherwise, well educated (age 35), good references.—Apply 6321, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN.—Does anybody want an industrious and trustworthy man to take charge of private plant, factory, small station, or anything? 13 years' experience, light, power, accumulators, &c., steam, gas, and water power.—6324, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN desires permanency, can estimate, take charge, &c., good wireman.—6310, ELECTRICAL REVIEW 4, Ludgate Hill, London.

ENGINEER and Fitter (27), four years sea-going in charge engines and boilers, holding B.O.T. certificate, desires situation as Junior Driver Mechanic in lighting station or power house. Commencing wage 20s. weekly, for experience.—6281, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER, A.M.I.E.E. (27), Electrical and Mechanical, six years' central station experience, including alternating (high and extra high-tension) and direct-current supply for lighting, power and traction purposes, also accumulators, requires post as Chief Assistant or Station Superintendent.—6255, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN, electrical and telegraph instruments, wide experience, energetic, good timekeeper, estimates, &c.—6320, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(*Continued on next page.*)

SITUATIONS WANTED.—*Continued.*

PUBLICITY.—Adept at preparation of catalogues, advertisements and all classes of advertising literature, engineering training, disengaged shortly.—6160, ELECTRICAL REVIEW, 4, Ludgate Hill, London

SALES Manager, well-up in all descriptions of Electrical Plant, Cables, &c., can handle large or small stuff; well-known; London District. — 6231, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

STOREKEEPER or Stores Clerk, seeks situation. Age 21. Experienced in contractors and wholesale business. Town or country. Highest references.—RIDDLE, 44, Geneva Road, Brixton, London. 6193

WIREMAN, quick, competent all systems, any distance, references.—85, Westbury Road, Ilford. 6218

WIREMAN, disengaged, seeks Employment; all systems; good references.— TOMLIN 60, Clarendon Street, Leamington. 6318

WIREMAN seeks engagement, town or country.—H. D., 84, Pelham Road, Wood Green, N. 6325

WIREMAN, disengaged; all-round experience.—H., 28, Cassland Road, Hackney. 6297

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ENGINEER (A.M.I E.E.), many years' central station and general experience, good testimonials, requires employment. Could invest small capital.—6313, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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AGENTS required in all large centres of the United Kingdom to represent manufacturers of British-made metal filament lamps upon commission terms.—Apply 6328, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENTS wanted in provincial centres for old-established firm of high-class Electric Lift and Crane Manufacturers. Only those having connection with leading architects, consulting engineers, contractors, and builders need apply.—Reply 6327, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.—*Continued.*

A.M.I.E.E., good connection, London district, is open to represent firm making V.I.R. Cables, &c.—6232, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMMERCIAL Engineer, Yorkshire connection, desires to represent good electrical house.—105, Exchange, Huddersfield. 6319

SMART Agents wanted in Leeds, Birmingham and Bristol to push the sale of well-introduced Flame and Enclosed Lamps. Only those with live connection with Engineering Works and Contractors need apply stating age, references, and full particulars of career to 5778, ELECTRICAL REVIEW, 4, Ludgate London.

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ELECTRICAL Contractor.—High-class suburb, S.W. district. Sacrifice at stock valuation, £150. Fine position, inclusive rent £20. Owner going abroad; excellent opportunity for branch. —6187, ELECTRICAL REVIEW, 4, Ludgate Hill, London

ELECTRICAL Contractor's Business for Sale, London district, flourishing business. Good connection. Fullest investigation; £350, stock included.—6217, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, in north-east coast town, Established Electrical Contractor's Business. Good workshop and offices; rent only £25; price £250—£350.— Apply 6182, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Mechanical or Electrical Business, from £200 to £500, must be sound and genuine affair, also show further scope with additional capital. — 6289, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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DYNAMOS, 3000, 1500, 1000 and 750 amperes, at 6 volts, ready for delivery; also smaller sizes delivered from stock. Machines let out on hire.—CANNING & Co., Electro-Platers' Engineers, Birmingham. 8025

(Continued on next page.)

FOR SALE.—*Continued.*

DYNAMO (Byng-Hawkins), 110 v., 450 amperes, 600 revs., compound.—MARTIN, Witton Road, Birmingham. 6183

DYNAMO by Elwell-Parker, 100—140 volts, 70 amps., 8-H.P. 110-volt Motor, condition as new, also 3-H.P. ditto, and smaller sizes in stock, for Sale cheap.—HARRY H. GARDAM, Staines. 4004

ELECTRICAL Plant.—One Parker's No. 12 Dynamo, set slide rails to ditto; one Otto Gas Engine, 24 B.H.P., and Self-starter, three Tanks, Volt-meter, Batteries, Switchboards and connections, all in excellent condition. To be sold at about half-cost price.—Apply THE BURTON BREWERY CO., LTD., Burton-on-Trent. 6337

FOR Sale.—Bound Volumes of "Proceedings of Institution Electrical Engineers" from 1890 to present time; also "Proceedings Institution Civil Engineers, from 1904 to date.—Offers to 6322, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, 24 KW. D.C. Generator Set, 530 to 110 volts, almost new, leading makers, cheap.—WINDER, Cross Belgrave Street, Leeds. 6258

FOR Sale immediately, Steam-Driven Electric Lighting Plant, consisting of:—100-B.H.P. Tangyes Horizontal Engine, with Pickering Governor, 75 lbs. steam pressure; four-pole Bruce Peebles Dynamo, compound wound, 300 amps. 255 volts; Switchboard, three marble panels with voltmeter and ammeter. May be seen in operation.—Further particulars may be obtained from, and offers to be sent to, HURST, NELSON & CO., Limited, Motherwell. 6259

FOR Sale.—Four nearly new 3-ton Electric Locomotive Travelling Cranes, made by Jessop and Appleby, each with 23 ft. steel braced derricking jib to lift 3-tons at 18 ft. radius, cast-iron carriage, doubled geared hoisting barrel grooved for ⅜" diam. steel rope 80 ft. long; worked by 30 H.P. series-wound reversing motor, 650 revs., 400 volts, raw hide pinion gearing. Type H.I "Brush" Controller, main switch fuse and resistance, automatic brake; corrugated iron sheeted cab. If voltage unsuitable, we are prepared to quote alternative prices for required voltage. Gauge 4′ 8½″ up to 12 feet to suit. Catalogues post free.—THOS. W. WARD, LTD., Albion Works, Sheffield. Telegraphic Address: "Forward, Sheffield." 6216

FOR Sale or Hire, high-class Dynamos, Motors, Alternators, Cable and Arc Lamps.—PERCY HUDDLESTON & CO., 72, Finsbury Pavement, E.C. 5689

NEW Dynamo (Compound), 80 volts 300 amps., £50; Dynamo, 40 amps. 140 volts, £17. — Apply 6311, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

20-H.P. Crossley Gas Engine, with tanks, pipes, &c., E.C.C. Dynamo, 100 v. 160 a., 915 r.p.m., Marble Switchboard, &c. All in perfect working order. Cheap.—HURRY BROTHERS, Sugar-house Lane, Greenock. 6314

ARTICLES WANTED.

WANTED TO PURCHASE FROM ELECTRIC LIGHTING Companies and Electrical Engineers, Dynamos, Motors, Cable, Wire, Instruments, and every description of Electrical Material, also Manufacturers' Surplus Stocks. The bulk being for re-use, high cash prices can be paid.—A. VEREY & CO., Dover. Principal in London three days a week. Telegraphic Address: "Verey, Dover." 8514

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ACCUMULATORS, Second-hand, any type, wanted; also Dynamos and Machinery, Lead Peroxide, Old Copper Cable, Scrap Metals, and every description of Metallic Dross purchased for cash, town or country.—Write A. BROWN & SONS, 142, Lower Clapton Road, N.E. Telephone: Dalston 555. 4338

OLD Electric Lamp Ends, Cable and Wire bought for cash.—SMITH & CO., 2, Ranelagh Road, East Ham, London, E. 2818

ONE 50-KW. and one 100-KW. (second-hand) three-phase, 50 cycles, 550-volts, direct-coupled Steam Sets, 70 lbs. steam pressure, or alternatively, three-phase Generators of these sizes to be belt-driven from independent engines. Prompt delivery required. Reply, giving full particulars and prices, to 6336, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & CO., LTD., 44, Clerkenwell Road, London. 6522

WANTED Surface Condenser about 5000 to 7000 lbs. of steam; also air and circulating pumps motor-driven. — Full particulars to 6225, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, 6 H.P. Motor, alternating 200 volts, 50 periods, also 4, 3, 2, & ½ H.P. ditto.—G., 163, Church Lane, Old Charlton. 6290

WANTED, 20 to 30 cwt. Electric Pulley Block Hoist for attaching to travelling crane 110 volts.—FIELDING & PLATT. Gloucester. 6331

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LEAD-Burning, Tanks, Accumulators, Oxy-Acetylene, Welding, Casting Repaired. Any distance.—H., 3, College Street, Putney. 6173

(Continued on next page.)

MISCELLANEOUS.—*Continued.*

TO THE TRADE.—Private lines erected, and all systems of intercommunicating telephones installed and repaired.—HORACE LAVY, Telephone Engineer, 6, Maddox Street, London, W. Telephone: Gerrard 8820. 6284

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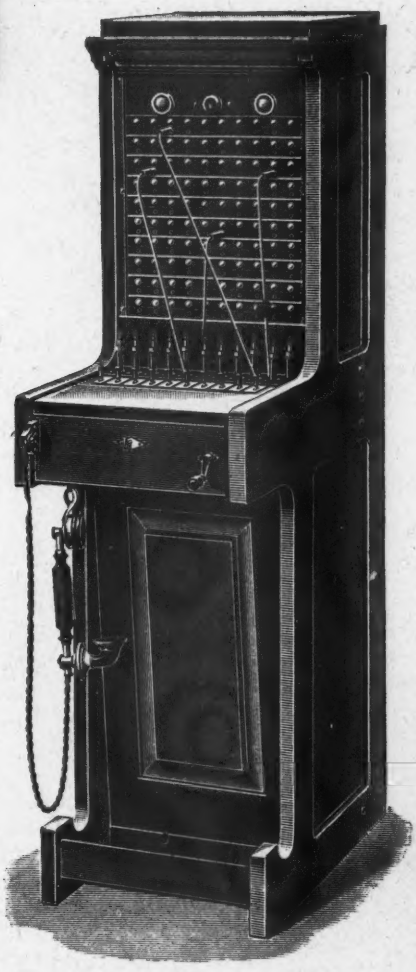

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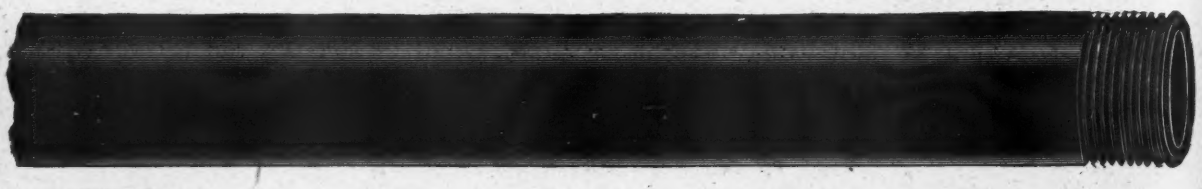

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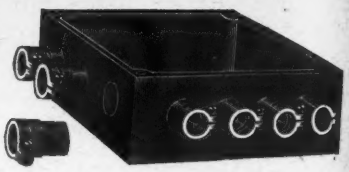

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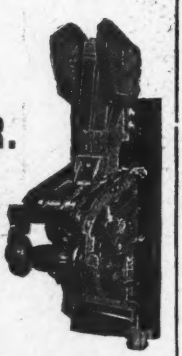

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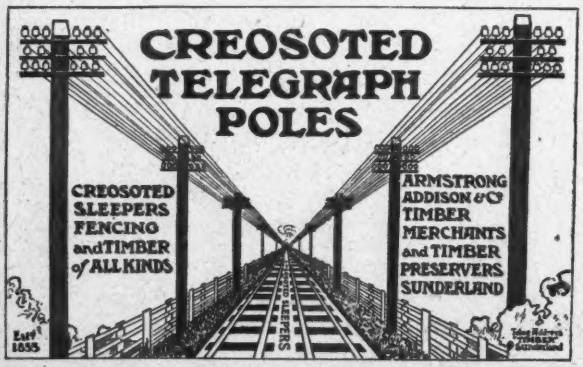
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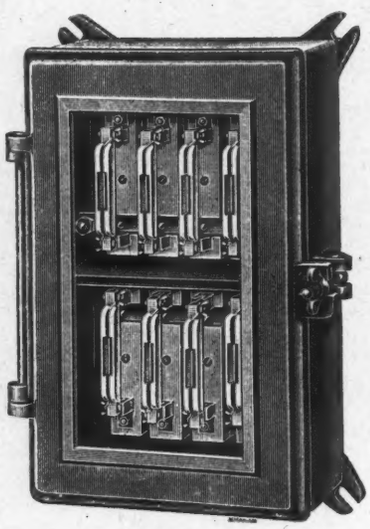

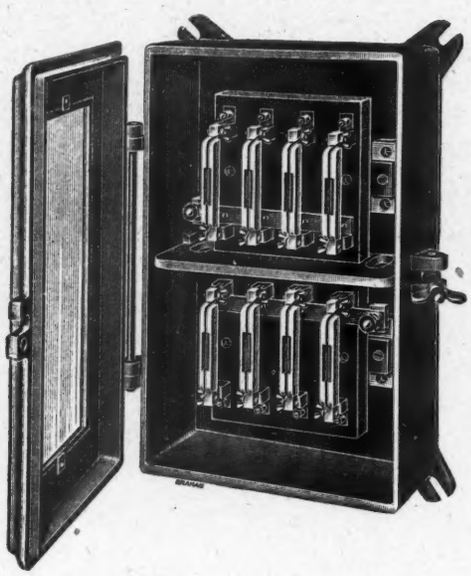

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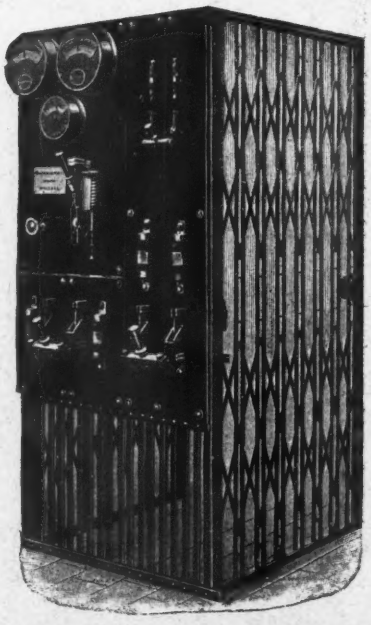

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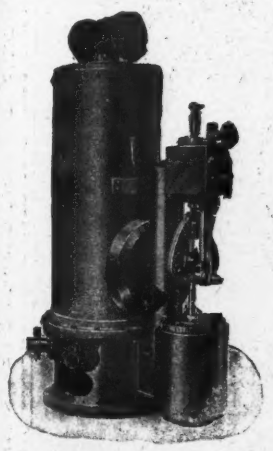

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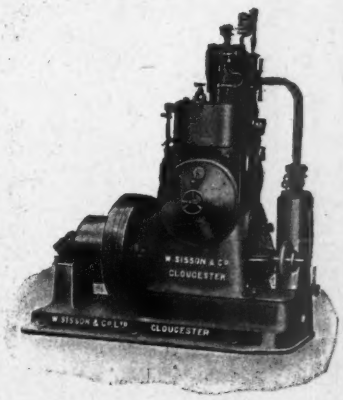

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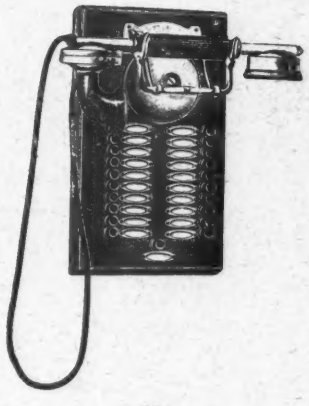

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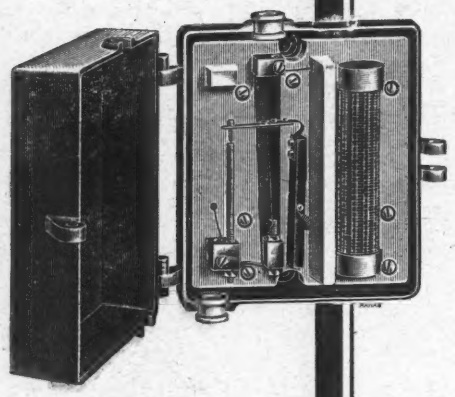

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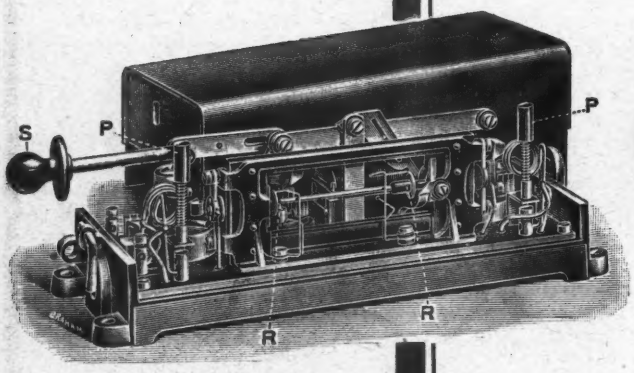

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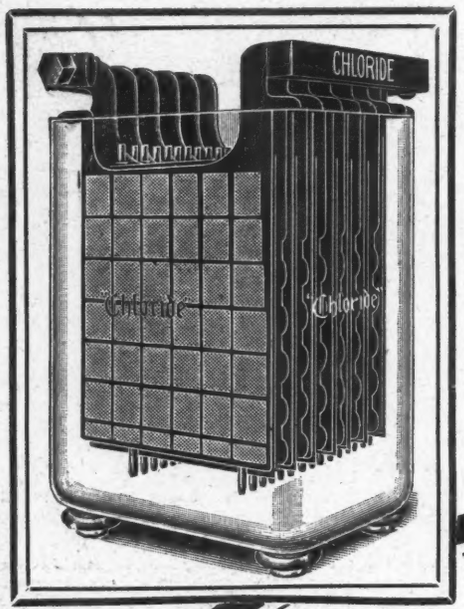
(*Continued on page 47.*)



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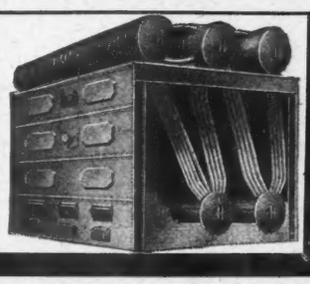

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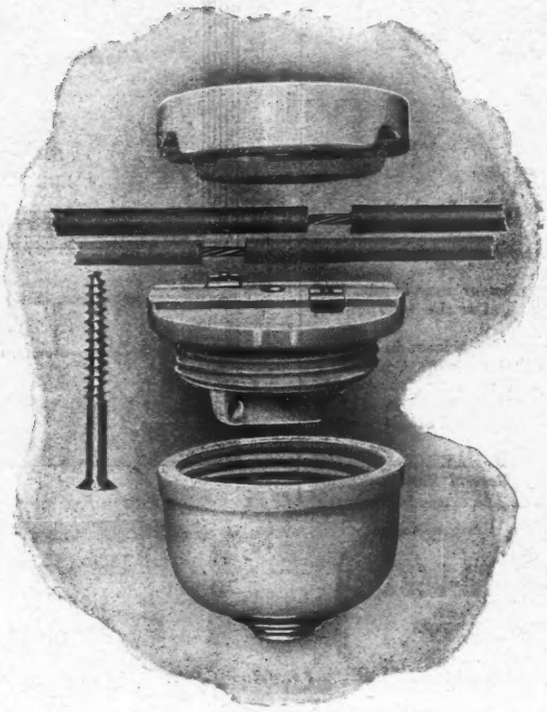

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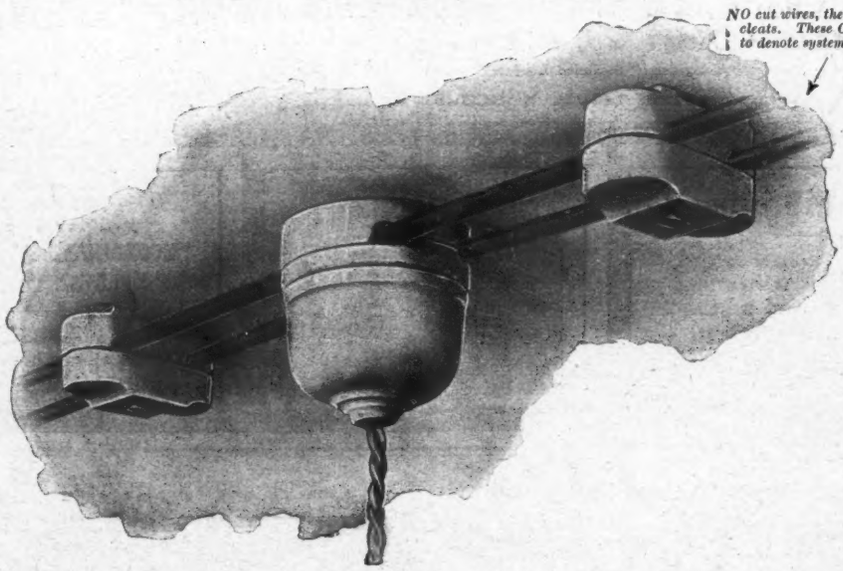

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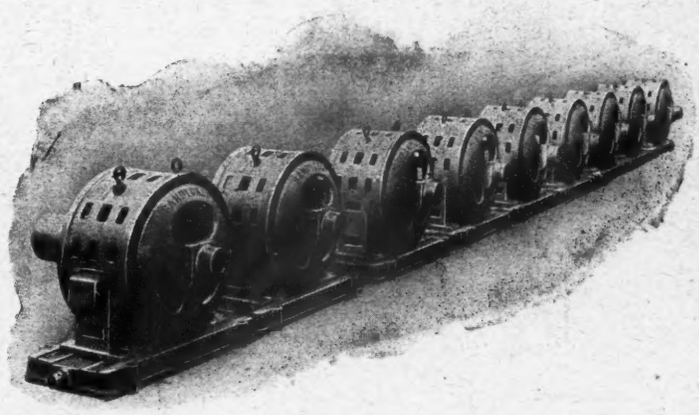

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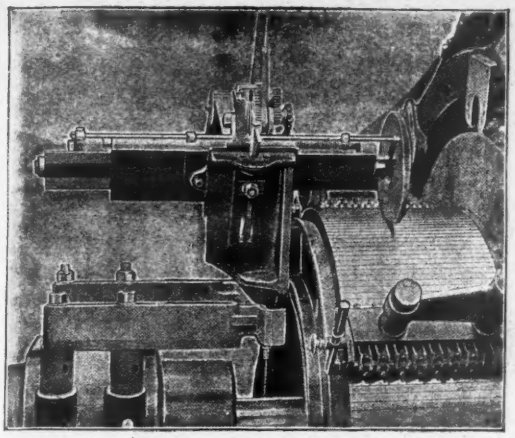

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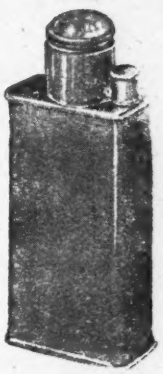

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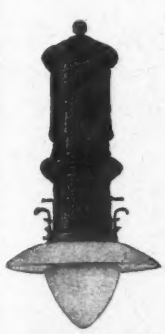

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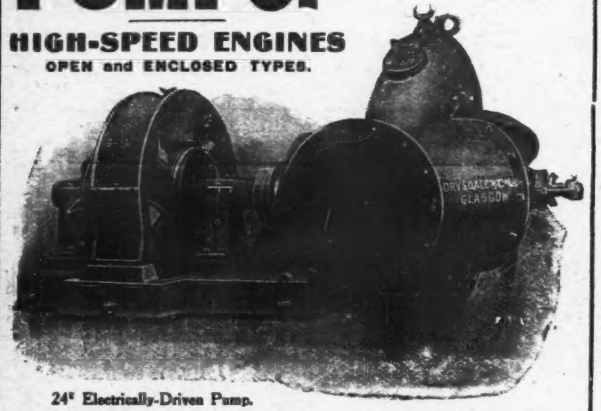

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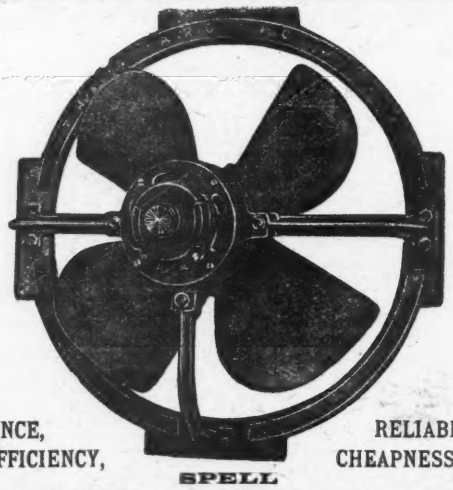

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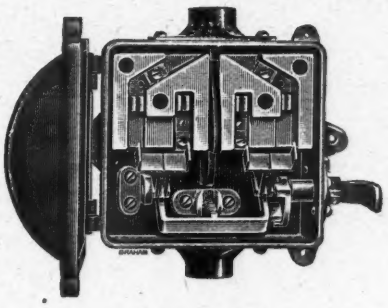

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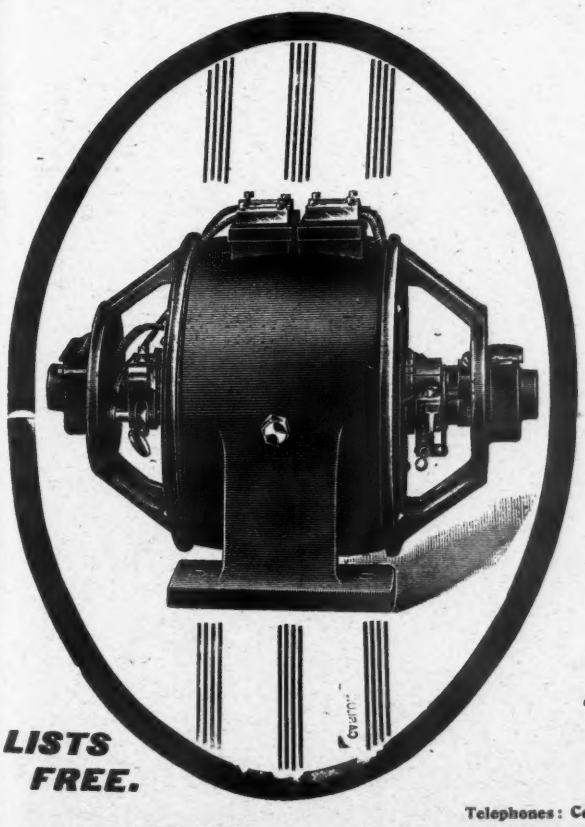

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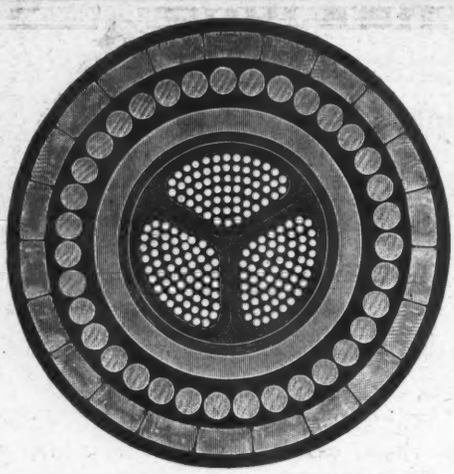

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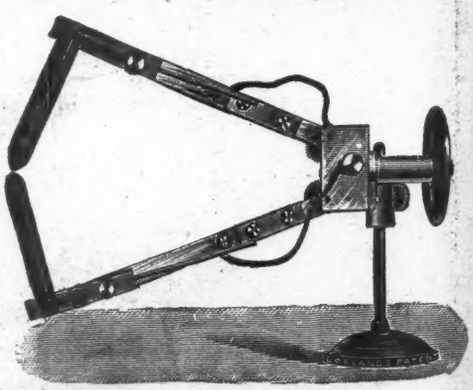

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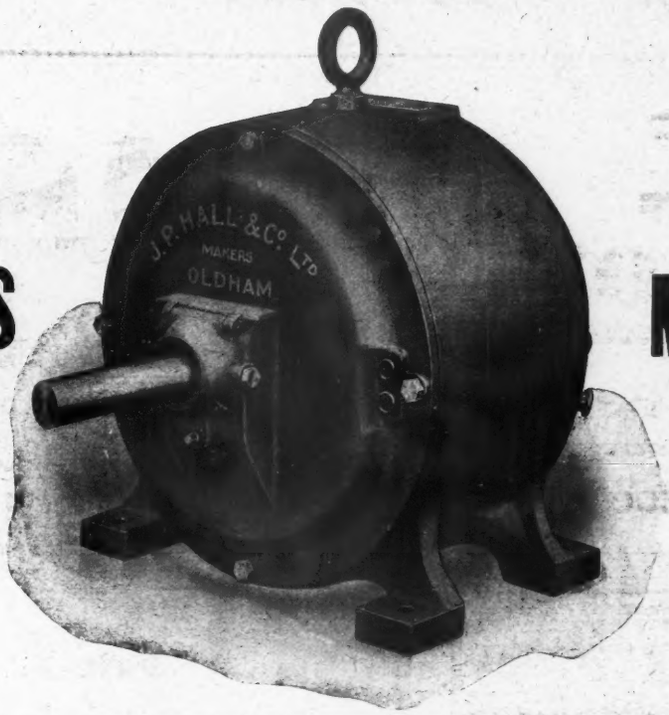

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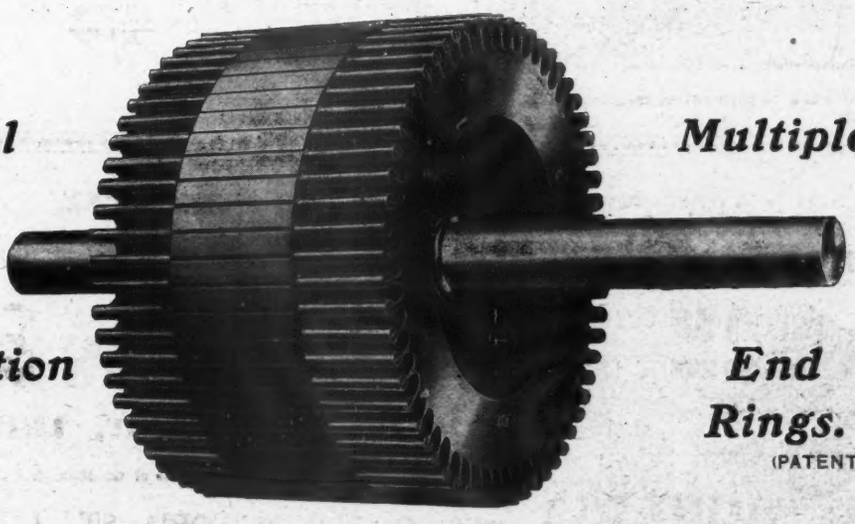

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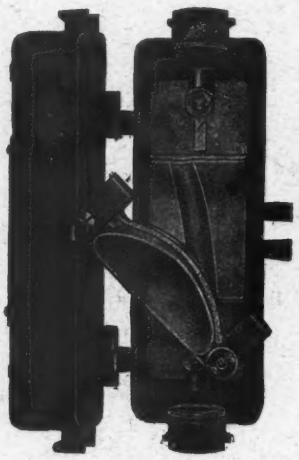

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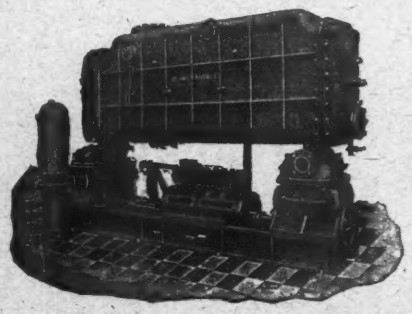

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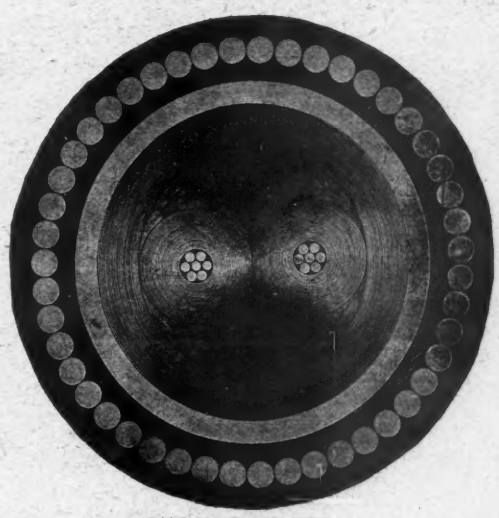

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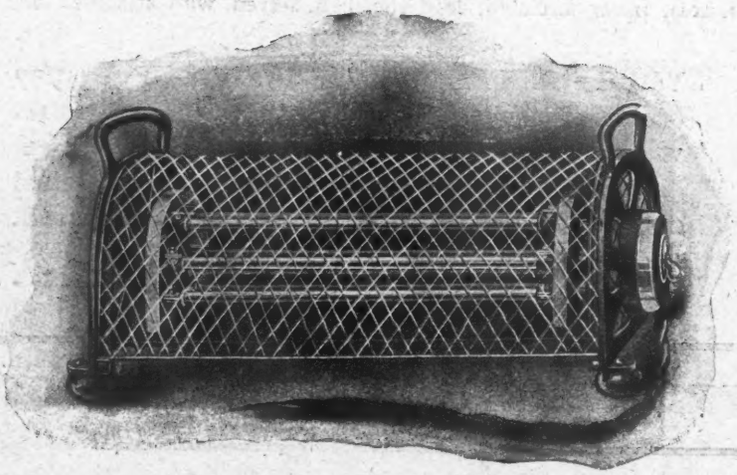

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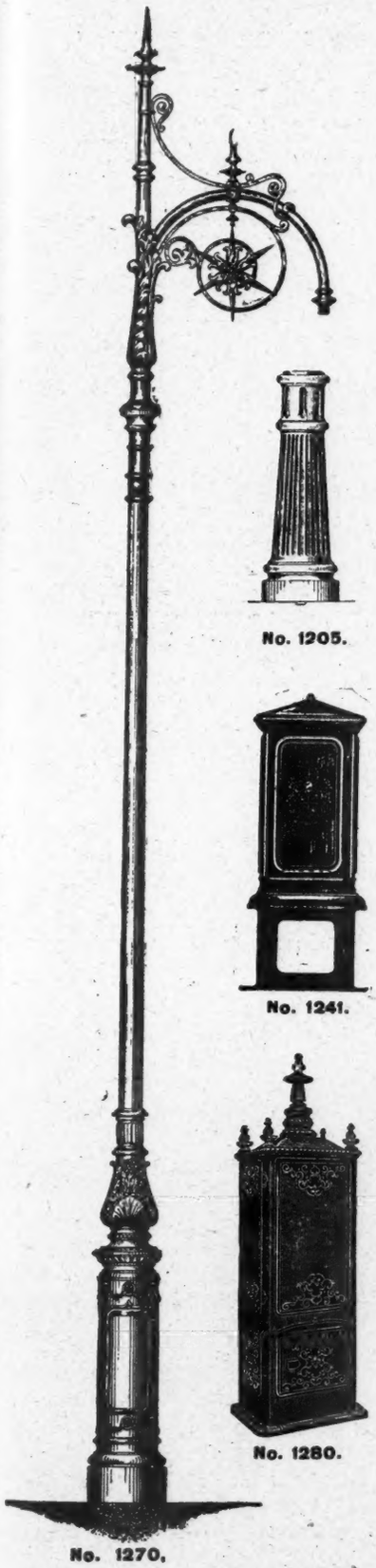

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ABERDEENSHIRE.—Alterations at United Free Church, Blairdaff by Kemnay; Kelly & Nicol, architects, 367, Union Street, Aberdeen.

ANNFIELD PLAIN (Co. Durham).—Five houses in William Street; W. G. Fawcett. Six houses in Mitchell Street; J. J. Bulmer.

ASHFORD.—Probable re-instatement (after fire) of portion of Eastwell House (premises lit by electricity), for H. J. King.

ATHERTON.—Further developments projected; Fletcher Burrows & Co.

AYLESBURY.—Alterations to business premises, Stoke Road, for P. J. Scott. Additions to factory, Clovelly Road, for G. A. Mower. Three houses, Highbridge Road, for Mr. Bligg.

BARNSLEY.—Four houses, Park Street, for T. Lindley. Six houses, Holgate Avenue, for E. W. Dyson. Four shops, Dodworth Road, for F. Hey. Four houses, Wilby Lane, for A. Wilby. Sixteen houses, St. Edmund's Avenue; W. Healey, builder, Barnsley. Rink, Doncaster Road; Central Hall Skating Rink Co., Barnsley.

BECKENHAM.—Additions to "Southmer," Westmoreland Road; J. Elliman, builder, Albermarle Road. Eight houses, St. James' Avenue; Hetherington & Co., builders. Eight houses, Elwill Way; H. & G. Taylor, builders, Park Langley.

BEDWELLTY.—Additions to the workhouse for the B.G. (£2,730).

BELFAST.—New premises in York Street and York Lane, for the Belfast Co-operative Society, Ltd.; S. Stevenson, architect, 83, Royal Avenue, Belfast. New theatre, corner of Grosvenor Road and Durham Street, for the Alexandra Theatre Co.

BOLTON.—Probable re-instatement (after fire) of portion of the Vernon Mill, for the Union Spinning Co. (premises lit by electricity; damage, £1,000). Developments and extensions at mills; Messrs. Ainsworth, spinners, Haslam Spinning Co., and Messrs. Crooks, spinners.

BRADFORD.—Warehouse and shed, for J. Ambler & Sons, Ltd., Midland Mills, Bradford; S. Jackson & Son, architects, 11, Tanfield Chambers, Bradford.

BRIGG.—Offices in connection with new steel works, for J. Lysaght, Ltd., Newport, Mon.

BRIGHTON.—Additional police offices at the Town Hall; Borough Surveyor, Town Hall, Brighton.

BRISTOL.—New music hall, at Bedminster, for Bristol Grand Theatre of Varieties, Ltd. (new company); J. Bannister Howard, director. Skating rink, with public hall and café, Park Row; M. Green, secretary of the company, 17, Bridge Street, Bristol. Additions to Eastville Workhouse, for the B.G.; J. J. Simpson, clerk, St. Peter's Hospital, Bristol.

BROADSTAIRS.—Shop and house, corner of Ramsgate Road and Queen's Road, for H. J. Harris; four houses and shops, Charlotte Street, for C. Britton. Two houses, Napier Road; A. Foster, architect, Pierremont Estate Office, Broadstairs.

BROMLEY.—Alterations to "Oldfield," Oldfield Road; F. P. Duthoit, builder, Westmoreland Road. Twelve houses, Foxbury Road; F. G. Crickett, architect.

BURSLEM.—Roller skating rink; E. T. Watkin, architect, Swan Chambers, Burslem.

BUTE.—Prospective rebuilding of Kyles of Bute Hydro (destroyed by fire); D. Hill, Jack & Sons, secretaries.

CADISHEAD (near Manchester).—Adaptation of patent fuel works for seed crushing; Secretary, Manchester Oil-seed Crushers, Ltd., 20, Princess Street, Manchester.

CANTERBURY.—Drill hall for the Kent Territorial Association (£5,975).

CASTLEFORD.—Premises, off Albion Street, for Lumb & Co., glass bottle manufacturers; offices, Bridge Street, for W. Shepherd.

CHELMSFORD.—Skating rink, for the Chelmsford Rink and Picture Palace Co.

CHIGWELL (Essex).—Dining hall, workshop, &c., and alterations to existing buildings at Chigwell School; H. Tooley, architect, Council Offices, Buckhurst Hill, Essex.

CHISWICK.—Two schools (300 places each); H. G. Crothall, architect, Middlesex Education Committee, Guildhall, Westminster, S.W.

CLEETHORPES (near Grimsby).—Public hall at rear of Council offices, for the U.D.C.

CLITHEROE.—Probable re-erection, after fire, of bungalow, Middlewood Hall, for W. King-Wilkinson.

COATBRIDGE.—Villa in Blair Road (£900); G. Reid, builder.

COLNE.—Probable re-erection, after fire, of premises, for the Liberal Club (damage, £2,000).

COPPULL (near Chorley).—New church, Park Road, gift of J. Darlington, The Hill, Lutterworth, and A. Hewlett, Haseley Manor, Warwick.

COVENTRY.—Proposed important additions to the Inland Revenue and County Court offices, for H.M. Office of Works, London.

CROYDON.—Adaptation of The Lindens and The Crosslands for children's homes (£800); H. List, clerk, Croydon Board of Guardians, Mayday Road, Thornton Heath.

DEVONPORT.—Married soldiers' quarters at Old Granby Barracks; Director of Barrack Construction, 80, Pall Mall, S.W.

DEWSBURY.—Residence, Healds Road; R. Castle & Son, architects, Cleckheaton.

DONCASTER.—New Roman Catholic Schools in Lord Street.

DUBLIN.—New boardroom and additions to offices, for the Rathdown Union; G. T. Moore, architect, 1 and 2, Foster Place, Dublin.

DUNDEE.—Rink, West End Street; R. M. Cameron, architect, 53, Great King Street, Edinburgh.

EPSOM.—Additions to Frances Lodge, Woodcote Sidy, for Gerrard Miles.

ERDINGTON (Birmingham).—Church; Rev. H. Roe, Homeleigh, Erdington.

EXETER.—Headquarters for Artillery Brigades (£6,000); Dymond & Parsons, architects, Southern Bay, Exeter.

FERRYHILL (Co. Durham).—Sixty-seven houses, Chilton Lane, for G. W. Lazenby.

GLASGOW.—Coffee factory at Shieldhall for Co-operative Society (£2,000); J. Davidson, architect, 95, Morrison Street, Glasgow.

HALIFAX.—Enlargement of the Post Office for H.M. Office Works, Storey's Gate, Westminster, S.W. Extensions to Stoney Royd Hospital, for the T.C. (£1,700); Mr. Lord, Borough Engineer. Branch Police Station at King Cross, for the T.C.

HASTINGS.—Two houses and shop, St. Helen's Down; F. H. Humphreys, architect, 6, Trinity Street, Hastings. Alterations to residence, "Westcliff," St. Leonards; Coussens & Rothwell, architects, Hastings. Alterations to "Vaenor," Laton Road, Hastings; Coussens and Rothwell, architects, Hastings. Alterations to Warrior House Hotel, St. Leonards; J. B. Wall, architect, 13, Devonshire Road, Bexhill. Pair of semi-detached villas, Barry Road, Silverhill, St. Leonards; D. J. Neame, owner and builder. Additions to business premises, 5, Claremont, Hastings; W. J. Taylor, architect, Hastings.

HATHERSAGE (near Sheffield).—Bank, for Crompton & Evans; J. B. Dalton, builder, Hathersage.

HYDE (Cheshire).—Six houses, Cleveland Avenue, for T. Fowden.

JARROW.—New public baths; J. H. Morton, architect, 50, King Street, South Shields.

KINGSTOWN (Dublin).—Probable rebuilding of premises of E. Lee, Ltd., after fire (£15,000).

LEEDS.—Training College and Hostels, Beckett's Park, for the T.C.; G. W. Atkinson, architect, 1, Mark Lane, Leeds.

LEITH.—Rope works at Morayfield, Restalrig, for J. Ross & Co., rope manufacturers, 23, Bath Street, Leith. Two new Salvation Army halls in Bangor Road.

LINTHWAITE.—Five houses, off William Street, Milnsbridge, for B. S. Butterworth. Four houses, Manchester Road, for J. Wimpenny and Co. Alterations to dye-house, Stanley Mills, for Crowther Bros.

LLANDYSSUL.—Residence (£600); W. D. Jenkins, architect, George Street, Llandilo; I. Jones, builder, Llangranog.

LLANELLY.—Drill hall, Murray Street, for the War Office.

LLANWRYTD WELLS (Brecon).—Boarding house (£1,500); W. D. Jenkins, architect, Llandilo, Carmarthenshire.

LONDON (S.W.).—Re-appropriation of A.S.C. Block and additions to provide accommodation for the R.A.M.C., Millbank; Director of Barrack Construction, 80, Pall Mall, S.W.

(Clapham Junction, S.W.).—Prospective rebuilding (after fire) of premises for Arding & Hobbs.

(Lewisham, S.E.).—Six houses, Arran Road; J. Watt, builder. The Lodge, Bromley Road, Catford, S.E. Six houses, Bromley Road; T. A. Boughton, builder, 87, Culverley Road, Catford, S.E. Eight houses, Brownhill Road; Norfolk & Prior, architects, 4, Station Buildings, Catford Bridge, S.E.

(Walthamstow, N.E.).—Six houses, Cazenove Road; H. Brodey, architect, 259, High Street, Walthamstow.

(Shepherd's Bush, W.).—Block of shops, Uxbridge Road (£6,600); F. H. Witts, architect, 89, Agate Road, Hammersmith, W.; Kingerlee & Sons, builders, Oxford.

(Tottenham, N.).—Additions to St. Andrew's Church, Clarence Road, for Rev. F. Rice. Two houses and shop, 75 and 77, Thackeray Avenue; G. W. Rowley, builder, 278, Philip Lane, N. Skating rink, High Road; Norfolk & Prior, architects, 4, Station Buildings, Catford Bridge, S.E.

(Buckingham Gate, S.W.).—Building, Wilfred Street; Barlow and Roberts, builders, 15, Redcross Street, Southwark, S.E.

(Blackfriars Road, S.E.).—Building, corner of Green Street and Friar Street; W. K. Smith, 52, Cann Hall Road, Leytonstone, N.E.

(Southwark, S.E.).—Building, Rockingham Street, for J. Newton and Co., hair felt manufacturers, Verney Road, Rotherhithe New Road, S.E.

(Lambeth, S.E.).—Six houses on site of Knolly's Croft, Leigham Court Road; F. P. Wooding & Son, builders, 3, Harborough Road, S.W.

(Stoke Newington, N.).—Mission Hall, Chapel Court, High Street; Humphreys, Ltd., builders, Knightsbridge, S.W.

(Wood Green, N.).—Public baths (£8,000); H. Burgess, architect, 51, Dunloe Avenue, West Green, N.

LYNTON.—Business premises, for A. Rose, fishmonger.

MALDON.—County school (500 places); A. S. R. Ley, architect, 55 Bishopsgate Street Without, London, E.C.

MALTON.—New post-office, for H.M. Office of Works, Storey's Gate, Westminster, S.W.

MARK (near Highbridge, Somerset).—Probable re-erection, after fire, of business premises, for W. G. Frost, grocer (damage, £1,000).

MEDOMSLEY.—Hall (£2,000); G. T. Wilson, architect, Blackhill; T. Gallagher, builder, Blackhill.

MICKLEOVER.—Wesleyan Church.

MORECAMBE.—Conversion of the Grand Hotel into hydro (£9,000).

MOSBOROUGH (near Sheffield).—Probable re-erection (after fire) of Knowle Hill Flour Mills, for B. Lawrence (damage, £1,200).

NEWCASTLE-ON-TYNE.—New naval shipbuilding yard, Walker, for Sir W. G. Armstrong, Whitworth & Co.

NEWPORT (Mon.).—Extensions to docks (electrically equipped) for the Cardiff Channel Dry Docks and Pontoon Co., Ltd.; Topham, Jones and Railton, Ltd., contractors, Newport. New works, Somerton Estate, for the manufacture of light iron goods, for a Birmingham firm.

NEWQUAY (Cornwall).—Alterations and additions to the Atlantic Hotel, for the Cornish Hotel Co.; G. Miners & Son, builders, Marazion.

NOTTINGHAM.—Probable reinstatement (after fire) of factory, Newdigate Street, for H. T. Gamble.

OCKLINGE.—Additions to St. Michael's Church (£10,000); the Vicar.

OLDHAM.—Church Institute (£2,500); C. Taylor, architect, 10, Clegg Street, Oldham.

PAISLEY.—New Ralston United Free Church (£2,250); W. D. McLennan, architect, 95, High Street, Paisley.

PITSEA (Essex).—County school (£3,000); F. Whitmore, county architect, Chelmsford.

PLYMOUTH.—Territorial headquarters, Millbay; F. A. Clark, architect, 88, Old Town Street, Plymouth.

PRESTWICH.—Primitive Methodist Church.

RAVENSTHORPE (Yorks.).—Laboratory at Howroyd & Oldroyd's chemical works. Fitting shed, for Bell Bros.

RAWMARSH.—Thirty-two houses; A. Pugh, builder, New Road, Rawmarsh.

READING.—Buildings in Earley Place, Minster Street, for W. L. Moule; buildings in Fobney Street, for H. & G. Simonds, Ltd., brewers, Reading; houses in Whitley Wood Lane, for W. Harrington, Whitley Wood Lane.

RHYL.—Pair of villas in Grange Road; R. Jones, 20, River Street. Addition to laundry, Grange Road.

RICHMOND-ON-THAMES.—Additions to Holbrook Motor Works, Hillrise, for R. Cowper & Son. Alterations to 1, Halford Road; Brewer, Smith and Brewer, architects, Richmond.

ST. ALBANS.—Artillery barracks, for the Herts Territorial Association; H. F. Mence, architect, Town Hall Chambers, St. Albans.

ST. IVES.—Proposed new municipal offices.

ST. MARGARETS-AT-CLIFF (near Dover).—Probable re-erection (after fire) of the Hope Inn, for Thompson & Son, brewers, Walmer.

SEAHAM HARBOUR.—Co-operative premises; Secretary, Ryhope and Silksworth Co-operative Society, Ltd.

SLOUGH.—Four houses, Arthur Road, for R. Cozens; skating rink, High Street, for A. C. Cornfield and R. Viveash.

SMETHWICK.—Bank, in High Street, for the London, City and Midland Bank, Ltd.; alterations to Beehive Inn, Cape Hill, and alterations to Blue Gates Hotel, for Mitchells & Butlers, Ltd.; 26 houses, in Arden Road, for C. Hougham.

SOUTHEND.—Alterations, Army and Navy Hotel, Marine Parade, for H. F. Holland.

SOUTH SHIELDS.—Alterations, Havelock Arms, for the Lawson Trust; F. Rennoldson, architect, King Street, South Shields. Houses, Sunderland Road, for T. J. & T. G. Bell; J. H. Morton, architect, King Street, South Shields. Café, in Sea Road, for W. Parker; C. W. Bell, architect, 17, Norfolk Street, Sunderland.

(Continued on page 62.)

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CONTRACTORS' COLUMN.—*Continued from page 60.*

STRETFORD (near MANCHESTER).—New works; Inman & Co., joiners, &c.
SWANAGE.—Two houses, King's Road, for G. Hardy. Ten houses, Chapel Lane, for J. Parsons. Houses, Court Hill, for F. W. Pond.
SWANSEA.—Additions and plant at the Lion stores, North Dock, for D. Jones and Co., wholesale provision dealers, Redcross Street, Liverpool (£2,000).
SWINDON.—Skating rink, for the Premier Rinks, Ltd., King's House. King Street, London, E.C.; Sutton & Gregory, architects, Bromley House, Nottingham.
TRURO.—Proposed conversion of Market House into public hall and skating rink, to be lit by electricity (£2,000); R. Thomas, Penzance, managing director of the syndicate.
WALKDEN.—Mill extension; Messrs. Storrs, contractors, Stalybridge.
WALLSEND-ON-TYNE.—Probable re-erection (after fire) of business premises, High Street East, for W. Broomfield, tailor (damage, over £2,000).
WARRINGTON.—Rebuilding shop (after fire) in Buttermarket Street; Mr. Knox, greengrocer.
WHITEHAVEN.—Alterations to business premises, Newtown, for Mr. Carr, jeweller.
WHITTINGTON (near LICHFIELD).—County school extensions (£1,021); E. J. Chattle, builder, Lichfield.
WIGAN.—Eight houses, bakery and stables, Roscoe Street and Hunt Street, for W. T. Speakman. Four houses, Platt Lane, for G. H. Rhodes. Houses and shops, Wigan Lane, for the Executors of the late T. Halton.
WINDLESTONE COLLIERY.—Twenty-seven houses; Pease & Partners, Ltd.
WOMBWELL (YORKS.).—Ten houses and shop, Main Street, for W. Johnson; three houses, Wath Road, for A. Dobson; skating rink, for the Wombwell Empire Skating Rink Co.
WORKINGTON.—Secondary and technical school (£14,000); Clark & Moscrop, architects, Darlington.
WORTHING.—Rink, Marine Parade (£6,000); C. A. Seebold, manager, The Royal Theatre, Worthing.
YARMOUTH.—Probable re-erection (after fire) of factory, for Slater & Sons.

Illustrated. XI. Tables.

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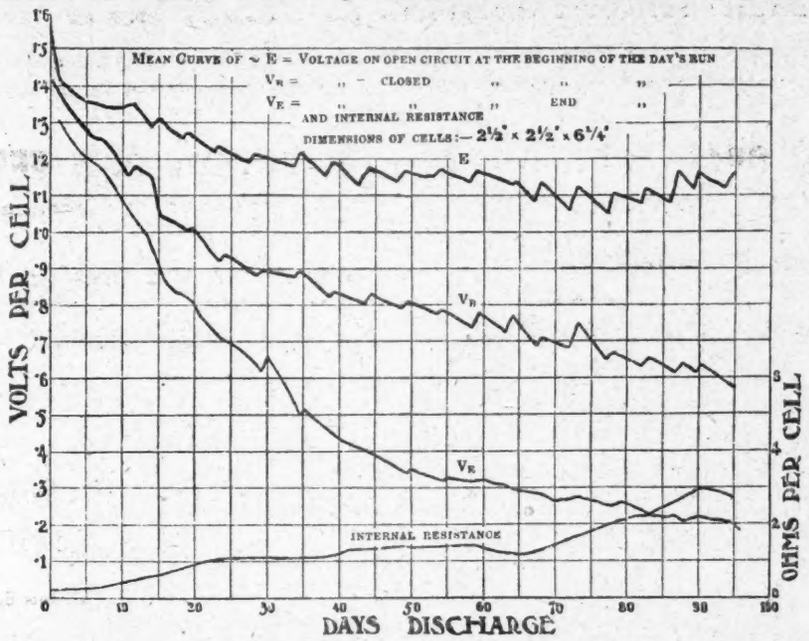
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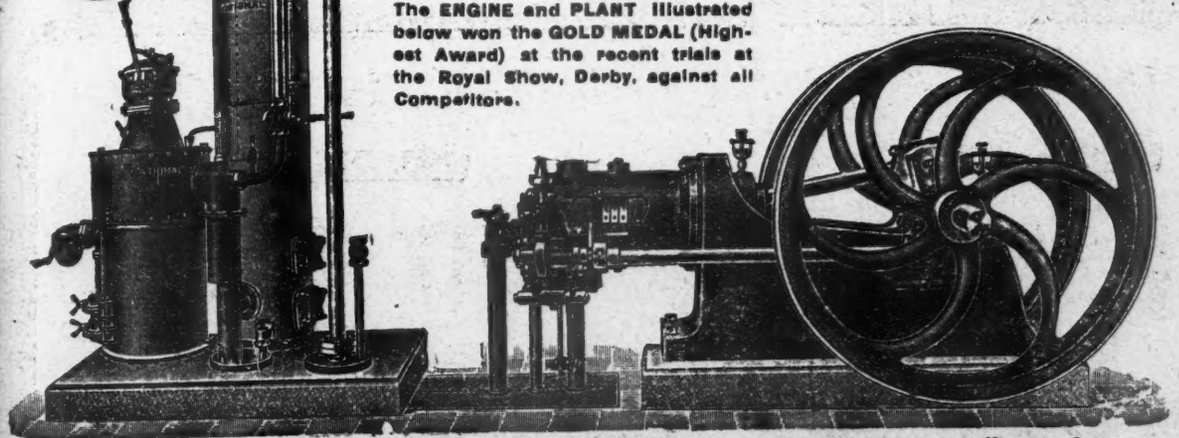

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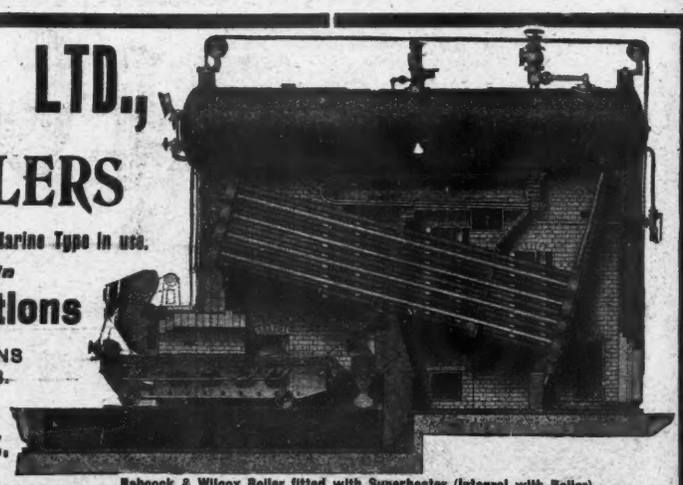

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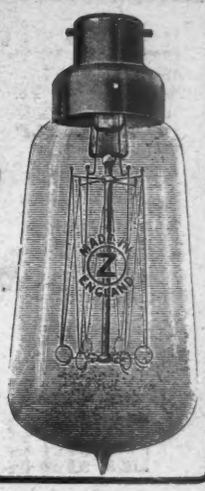

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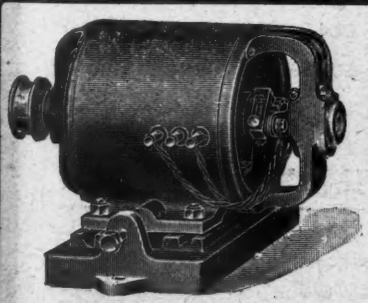

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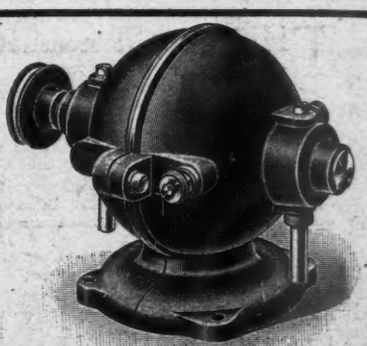

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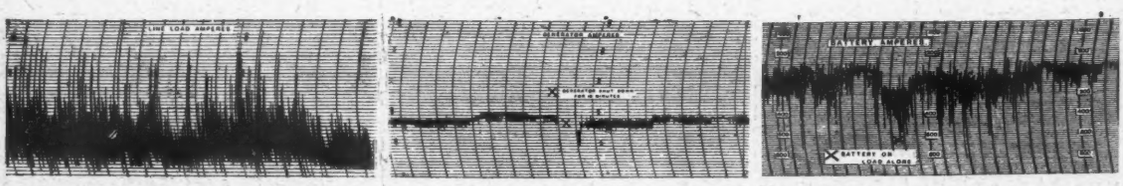

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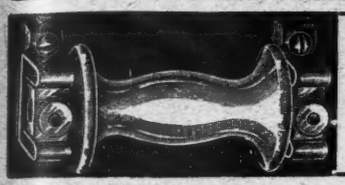

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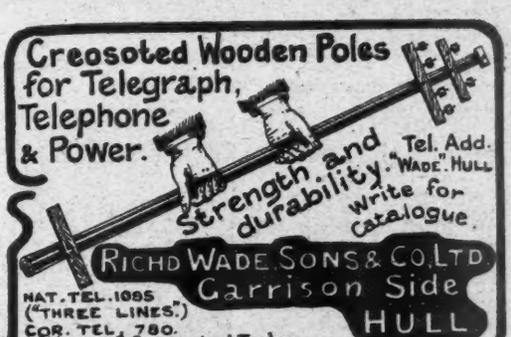

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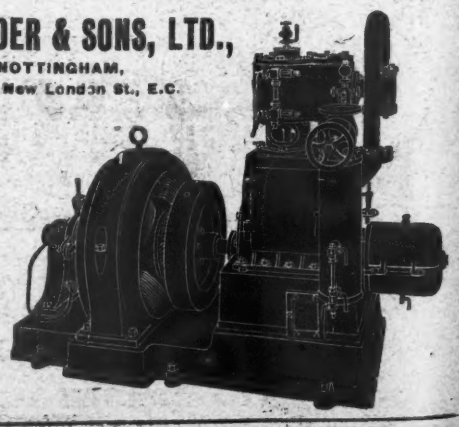

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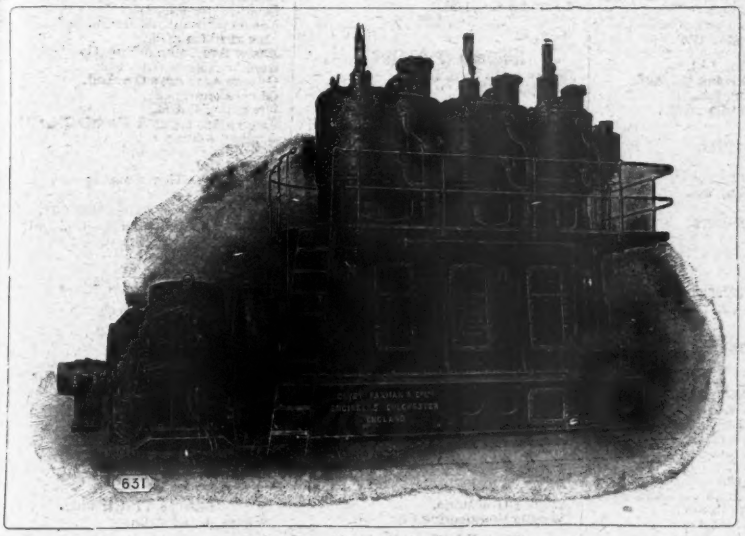

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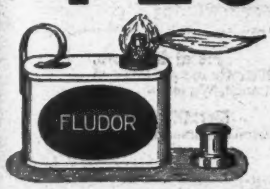

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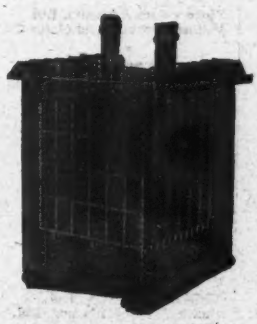

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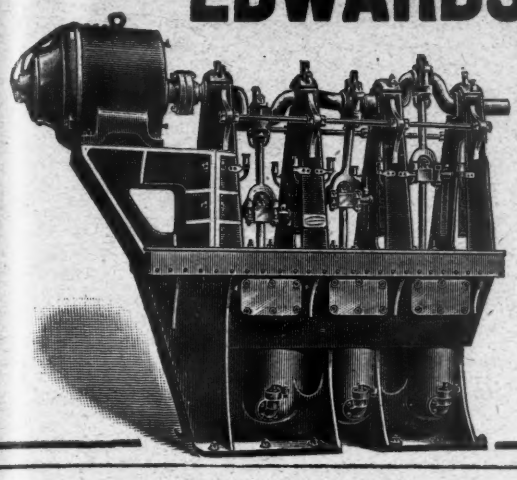

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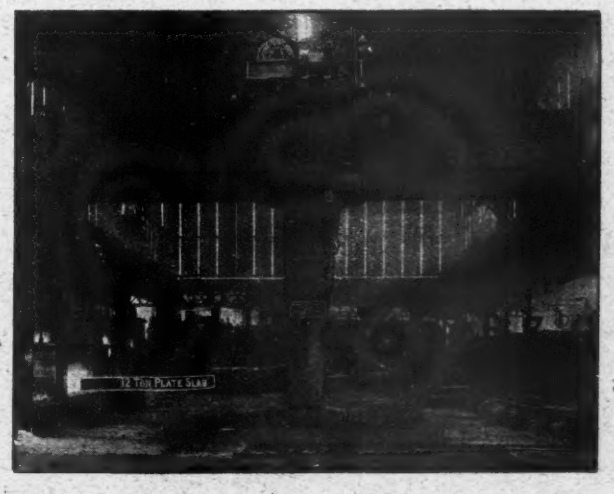

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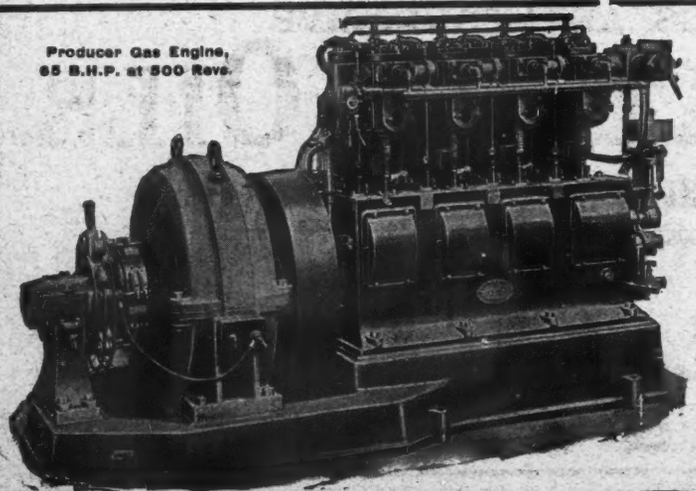

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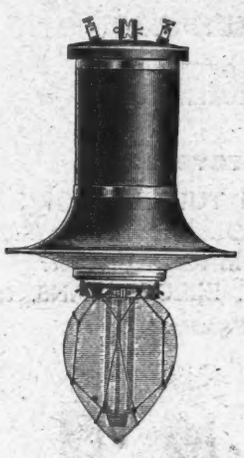

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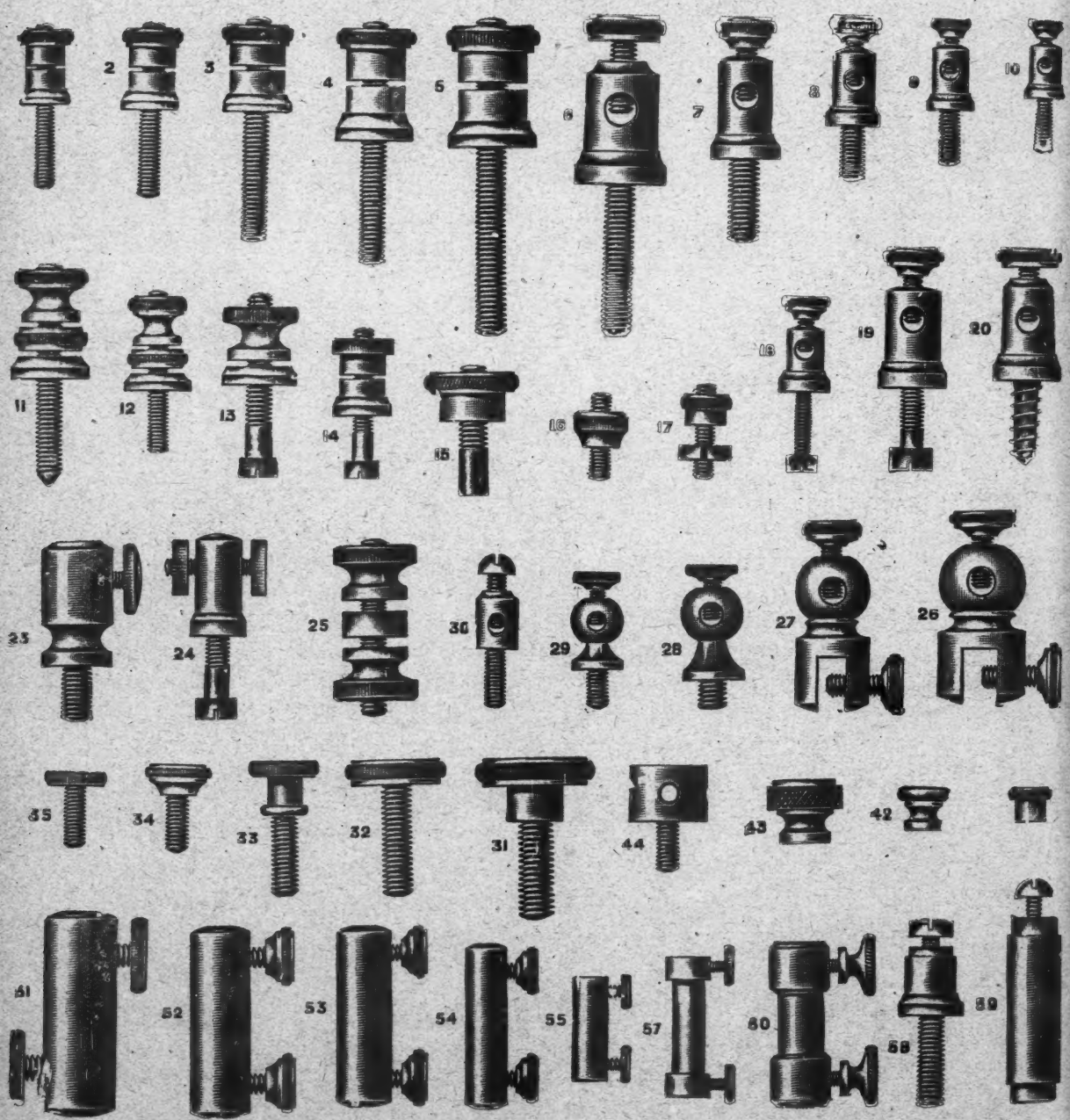

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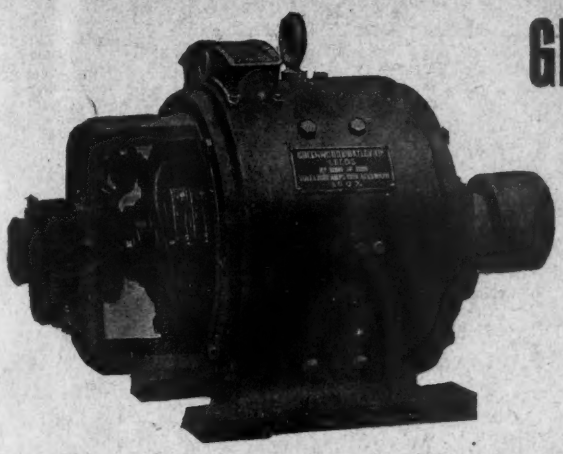

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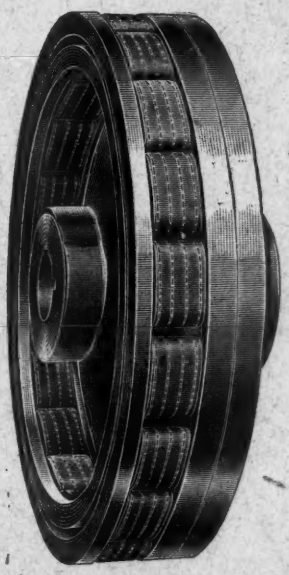

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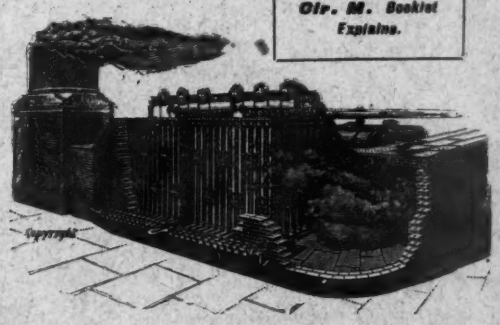

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